GRIFFIN'S SCIENTIFIC TEXT-BOOKS

A LABORATORY COURSE

OF

PHARMACY AND MATERIA MEDICA.

A LABORATORY COURSE

OF

PHARMACY AND MATERIA MEDICA:

INCLUDING THE

PRINCIPLES AND PRACTICE OF DISPENSING.

ADAPTED TO THE STUDY OF THE BRITISH PHARMACOPŒIA AND THE REQUIREMENTS OF THE PRIVATE STUDENT

BY

WILLIAM ELBORNE,

LATE ASSISTANT LECTURER IN MATERIA MEDICA AND PHARMACY IN THE OWENS COLLEGE MANCHESTER; MEMBER OF THE PHARMACEUTICAL SOCIETY OF GREAT BRITAIN; FELLOW OF THE LINNEAN AND CHEMICAL SOCIETIES OF LONDON

With Illustrations and Lithographed Plates.

LONDON:
CHARLES GRIFFIN AND COMPANY,
EXETER STREET, STRAND.
1890.

PREFACE.

Seven years ago, a course of systematic instruction in Practical Pharmacy for medical students was instituted at The Owens College, in connection with which I have from its commencement been associated as Assistant Lecturer.

It has since been customary to offer the medical students attending the annual course of lectures on Materia Medica a voluntary short laboratory course of instruction in the chemical portion of the subject—an offer which has met with their ready acceptance.

The success which has attended our work has induced me to publish the following notes, to be used in conjunction with any of the existing text-books on "Materia Medica and Pharmacy."

W. E.

Cambridge, *April* 1890.

CONTENTS.

INTRODUCTION.

PART I.

CHEMICAL PHARMACY.

PART II.

Galenical Pharmacy.

PART III.

APPENDIX.

ERRATA.

Page 25, bottom line, *for* "water, cellulose, and mineral salts" *read* "and cellulose."

,, 26, line 12, . *for* "*e.g.*, water, ash, essential and fixed oils" *read* "*e.g.*, essential and fixed oils."

,, 142, ,, 7, . *for* "Ammonia" *read* "Ammoniæ."

,, 169, ,, 14, . *for* "about 5 to 10" *read* "about 5 to 10 grains."

,, 214, ,, 19, . *for* "of this" *read* "of the latter."

A LABORATORY COURSE

OF

PHARMACY AND MATERIA MEDICA.

Introduction.

The Laboratory work pertaining to the Chemical and Galenical sections in the following pages is intended as a supplementary practical course of instruction for students, who, having previously studied Chemistry, Physics, Practical Chemistry, and Botany, are now attending a systematic course of lectures and demonstrations on the Materia Medica, and pursuing a practical course of Dispensing.

A synopsis of such previous work will be found in the Appendix.

A Pharmacopœia is a book published by the authority of a Government, State, medical, or pharmaceutical body, containing directions for the identification of the more important mineral, vegetable, and animal substances used as medicines, and formulæ for the preparation and identification of such recognised medicinal compounds as it is desirable should possess a uniform composition. "The progress of medical knowledge during the last two hundred years has led to a gradual, but very perceptible, alteration in the contents of the various pharmacopœias. The original very complex formulæ have been gradually simplified until only the most active ingredients have been retained, and in many cases the active principles have to a large extent replaced the crude drugs from which they were derived. From time to time such secret remedies of druggists or physicians as have met with popular or professional approval have been represented by simpler official preparations" (*Encycl. Britannica*).

The British Pharmacopœia.[1]—By the Medical Act of 1858, section 54, it is enacted "that the General Council shall cause to be published under their direction a book containing a list of medicines and compounds, and the manner of preparing them, together with the true weights and measures by which they are to be prepared and mixed, and containing such other matter and things relating thereto as the General Council shall think fit, to be called 'British Pharmacopœia;' and the General Council shall cause to be altered, amended, and republished, such pharmacopœia as often as they shall deem it necessary." The British Pharmacopœia is, therefore, an authoritative manual "intended to afford to the members of the medical profession and those engaged in the preparation of medicines throughout the British Empire one uniform standard and guide, whereby the nature and composition of substances to be used in medicine may be ascertained and determined" (*Brit. Pharm.*). The last edition was published in 1885.

The Materia Medica, a collective name given to the remedial agents used by physicians in the treatment of disease, embraces a large number of substances derived from the three kingdoms of nature, the mineral, vegetable, and animal. A scientific knowledge of these individual substances—a correct acquaintance, for instance, with their natural history, physical characters, and chemical properties—pertains to the science of *Pharmacognosy.*

Since, however, few substances are found in nature in a fit state for their exhibition and administration in medicine, the various processes to which it is necessary to submit them for this purpose constitute the science and art of *Pharmacy.*[2]

Pharmacy may be divided into three branches :—

Chemical Pharmacy.
Galenical Pharmacy.
Dispensing.

[1] Our first official pharmacopœia, entitled *Pharmacopœia Londinensis, in qua Medicamenta antiqua et nova usitatissima collecta, opera Medicorum Collegii Londinensis*, was published by the Royal College of Physicians of London in 1618 ; the last edition in 1851. Later, there were also pharmacopœias issued in Edinburgh and Dublin ; these, together with the above-mentioned work, were superseded by the "British Pharmacopœia" of 1867. Many hospitals, infirmaries, and dispensaries throughout the United Kingdom possess in use additional private pharmacopœias and formularies of their own—containing for the most part chiefly galenical recombinations of the material of the British Pharmacopœia adapted to their own special requirements. A dispensatory is a commentary on pharmacopœial formularies.

[2] *Pharmacology* is the science which treats of the physiological action of drugs upon the healthy organism. *Therapeutics* is the science which treats of the application of medicines to the alleviation and cure of disease.

(*a*) **Chemical Pharmacy** comprises the preparation of all medicinal substances possessing a definite chemical constitution—for example, of all acids, salts, and carbon compounds, with their pharmacopœial preparations, including the extraction and preparation of the various organic acids, alkaloids, glucosides, and other chemical products derived from vegetable and animal substances.

(*b*) **Galenical Pharmacy**[1] has for its scope the preparation,

[1] Claudius Galen: A.D. 130–200. Author of Περὶ Συνθέσεως Φαρμάκων. "Formerly, that is, in the time of the early medical writers, among whom Galen (a native of Tnrkey, who lived in the second century) was one of the most celebrated, medicines were for the most part derived from the vegetable kingdom. At a later period, in the fifteenth century, Basil Valentine, and after him Paracelsus, introduced chemical medicines of mineral origin. Much contention long continued to prevail among the respective advocates of these two classes of remedial ageuts, the former of which came to be designated 'galeuical' and the latter 'chemical.' The spirit in which the controversy was sometimes conducted may be inferred from the recorded fact that Paracelsus, who was Professor of Medicine and Natural Philosophy at Basel in Switzerland, commenced his course of lectures by igniting sulphur in a furnace, and putting something representing the works of Galen and Avicenna into the flames, exclaimed: '*Sic vos ardebitis in gehennâ.*' . . . . Galenical medicines, then, are products of the art of pharmacy as applied to natural substances for the purpose of adapting them for medical use, while they still remain mere mixtures of more or less active as well as inactive constitnents. These products as now used in medicine, or the active parts of them, are principally derived from the vegetable kingdom, but they cannot be said to be so derived exclusively, nor iudeed was this ever strictly the case. Their indefinite character, as mere mixtures of ingredients which cannot be chemically defined, constitutes their distinguishing feature. We call them galenical preparations, but there are probably none of them made now as they were in the days of the father of medicine. It appears to have been an object then and long afterwards to complicate the composition of medicines by mixing together a large number of natural products, as if it were thought that failing one, some other might hit the disease. Thus, for instance, the old 'mithridate,' and the so-called 'theriaca' or 'Venice treacle,' for which formulæ were given in the London Pharmacopœia, even down to 1746, contained some fifty or more ingredients; and an old Paris Pharmacopœia ordered a plaster containing sixty ingredients, and a distilled water made from one hundred and twenty ingredients. The tendency in modern days has been greatly to simplify the composition of medicine as compared with those of former days. Nevertheless it has usually been, and still is, considered desirable in the preparation of many galenic medicines to associate together a certain number of natural products with a view of correcting some of the properties, it may be, of each, and at the same time of developing properties which are most effective for the purpose contemplated. Although many of the most active, reliable, and valuable of our therapeutic agents belong to the class of definite chemical compounds, yet these do not constitute the most numerous class, for that is found among the galenical preparations. In the production of this numerous class of medicines, chemically indefinite as they are, there is ample room for the exercise of much skill and judgment, and for the application of scientific knowledge. Moreover, the skill and judgment involved in their production must be acquired from

together with the general and abstract processes involved in the same, of all medicinal and pharmacopœial products which are not of a definite chemical constitution, but mere mixtures of active and inert substances, *e.g.*, infusions, decoctions, &c. The modern tendency is to standardise the more important of these products as regards, at least, the active principles which they contain, *e.g.*, *Extractum Nucis Vomicæ*, *Ext. Cinchonæ Liquidum*, *Opium*.

(*c*) **Dispensing** is the art of compounding medicines from magistral formulæ (prescriptions).

The *practice* of pharmacy embraces chiefly galenical pharmacy and dispensing,—chemicals, crude drugs, and the active principles dealt with therein being (with but few exceptions) obtained from manufacturers and wholesale druggists.

The departments of an ordinary dispensing establishment are usually :—

(1) The dispensary proper, where prescribed medicines are compounded, and where a sufficient quantity of each drug or preparation is kept in readiness for immediate use, together with the requisite apparatus for their manipulation.

In its arrangement, the chief objects are to diminish labour, to prevent mistakes and accidents,[1] and to be such as may be readily understood by new dispensers.

(2) The laboratory, where the majority of the galenical preparations are made, having all fixed apparatus properly disposed—an efficient stove with steam and water-bath, a heavy bell-metal or iron mortar, a press, a good working-bench with well-secured racks and shelves for mortars, percolators, funnels, &c.; it should also include a complete set of chemical reagents, test-tubes, dishes, &c., and, lastly, gas, and water-supply and sink.

(3) The store, consisting of different apartments :—(*a*) A Drug-

experience, and in some respects are more dependent upon careful intelligent observation and comparison of effects and results, than is the case in the production of definite chemical products" (Professor Redwood on "Galenical Pharmacy," *Pharm. Jour.* [3], vol. xvi. pp. 1010, 1011).

[1] **Recommendations by the Pharmaceutical Society of Great Britain for the keeping of Poisons.**—(1) That in the keeping of poisons, each bottle, vessel, box, or package containing a poison be labelled with the name of the article, and also with some distinctive mark, indicating that it contains *poison*. (2) Also that in the keeping of poisons, each poison be kept on one or other of the following systems, viz :—(*a*) In a bottle or vessel tied over, capped, locked, or otherwise *secured in a manner different from* that in which bottles or vessels containing ordinary articles are secured in the same warehouse, shop, or dispensary ; or (*b*), in a bottle or vessl rendered *distinguishable by touch* from the bottles or vessels in which ordinary articles are kept in the same warehouse, shop, or dispensary ; or (*c*), in a bottle, vessel, box, or package kept in a room or cupboard *set apart for dangerous articles*.

room for substances which sustain the ordinary atmospheric changes without suffering material injury. (*b*) A Cellar for substances requiring a uniform cool temperature.

The departments of a School of Pharmacy are usually :—

(1) A Materia Medica Museum, where students for purposes of study have access to typical specimens of the materia medica, *i.e.*, the pharmacopœial chemical substances and the crude drugs of vegetable and animal origin.

(2) One or more lecture theatres.

(3) A Pharmaceutical Laboratory. { (*a*) A Chemical Laboratory. (*b*) A Galenical Laboratory.

(4) A Dispensary.

(5) A Botanical Garden, with hot-house, for the study of medicinal plants from the life.

Weights and Measures.—"The grain weight, established by law in this country, is well known and well defined. It has been in use from a very remote period, and forms a convenient unit for estimating the weight of many medicines. The avoirdupois ounce and pound, being the weights practically used in the sale of medicines and generally in commercial transactions, were adopted in the edition of 1864, and are still retained in preference to troy weights of the same denominations. It must be admitted that the absence in the present system of any denomination of weight between the grain and the avoirdupois ounce of 437·5 grains, and the fact that the ounce is not a simple multiple of the grain, are grave defects; still, it has not been thought desirable to make any change in this respect at present, especially as no practical inconvenience appears to be experienced *in preparing* by means of these weights the medicines ordered in the pharmacopœia. It is strongly urged upon all medical men to avoid the use of the terms 'ounce' and 'pound' with reference to any other than the avoirdupois or imperial standard weight; but it will be optional with the physician *in prescribing* to use the symbols ℈ and ʒ, the former representing 20 and the latter 60 grains, if such should be found to conduce to accuracy or convenience. In the measurement of liquids the imperial measure is used for the higher denominations, and the fluid ounce and its subdivisions into fluid drachms and minims for the lower denominations of volume. These measures are convenient, and have become familiar, having been used throughout the United Kingdom for many years."

In the 1885 revised edition of the British Pharmacopœia, "an attempt has been made to introduce a method of setting out the relative quantities of ingredients used in some of the processes by supplementing the respective weights and measures by proportional parts. It was at first proposed that the use of parts should altogether supersede that of specified weights and measures, but it

was thought better, at least for the present, merely to supplement weights and measures by parts where the context permits and where this can be made more clearly to show the proportion which the several parts bear to each other. Wherever this method is employed, the term 'parts' signifies parts by weight, and the term 'fluid parts' signifies the volume of an equal number of parts of water" (*Brit. Pharm.*).

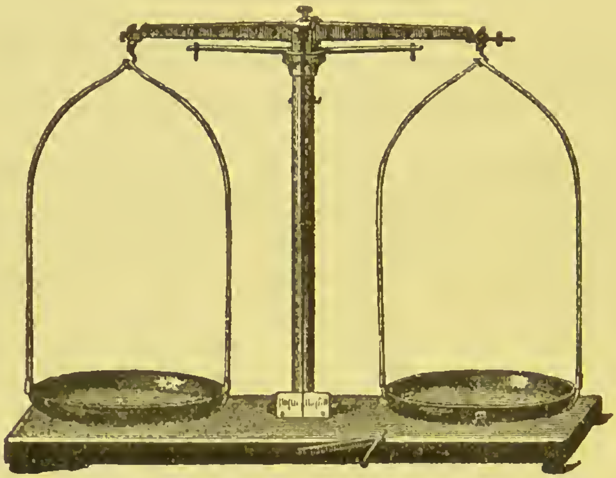


FIG. 1.—Balance for a charge of 2 lbs. in each pan (diameter of latter 6 inches).

The weights and measures adopted in the British Pharmacopœia for the preparation of both chemicals and galenicals are, consequently, those by which all other commodities (including drugs) are bought and sold in English commerce—viz., the ordinary avoirdupois weights and imperial measures.[1]

FIG. 2.—A set of avoirdupois weights, 16 oz. to ¼ oz.

Weights (Avoirdupois).

1 Grain	gr.			
1 Ounce	oz.[2]		=	437·5 grains.
1 Pound	lb.	= 16 oz.	=	7000 grains.

[1] "Every measure and weight whatsoever used for trade shall be verified and stamped by an inspector with a stamp of verification under this Act. Every person who uses or has in his possession for use for trade any measure or weight not stamped as required by this section shall be liable to a fine not exceeding five pounds, or in the case of the second offence ten pounds, and shall be liable to forfeit the said measure or weight, and any contract, bargain, sale, or dealing made by such measure or weight shall be void" (*An Act to Consolidate the Law relating to Weights and Measures*, 1878, 41 and 42 Vict. cap. 49).

[2] The sign ℥ = 480 grains ("Apothecaries" ounce weight).

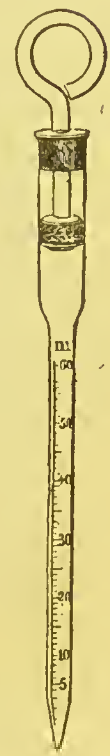
Measures of Capacity (Imperial).

60 Minims	= 1 fluid drachm	(fl. drm.)	} [1]
3 Fluid drachms	= 1 fluid ounce	(fl. oz.)	
20 Fluid ounces	= 1 pint	(O.) Lat. *Octarius.*	
8 Pints	= 1 gallon	(C.) „ *Congius.*	

Relations of Measures to Weights.

1 Minim[2]	is the measure of		0·91 grain of water.	
1 Fluid drachm	„	„	54·687 grains	„
1 Fluid ounce	„	„	437·5 (the avoirdupois ounce.) „	„
1 Pint	„	„	8750·0 „	„
1 Gallon	„	„	70000·0 „	„

The "fluid grain" is the volume of one grain of water at 60° F.



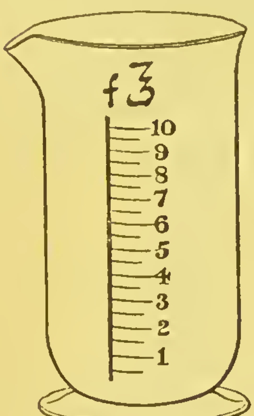


Fig. 3.—A half-pint glass measure divided into fluid ounces.

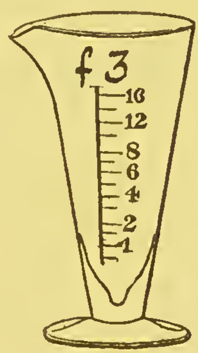


Fig. 4.—A two-ounce measure divided into fluid drachms.

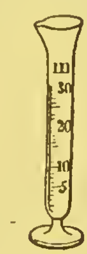


Fig. 5.—A minim measure.

Fig. 6.—A minim measure(syringe).

[1] The sign ʒ for fl. drm., ℥ for fl. oz., are *also* frequently used in prescribing in the directions for the measurement of *liquids;* the above fluid measures are intended to be used in such cases. They are the respective abbreviations of the apothecaries' drachm and ounce "weights."

[2] Medicines are sometimes prescribed in "guttæ" or drops; the latter are, however, very vague quantities, varying in size not only according to the sp. gr. and viscosity of the liquid, but also with the size and shape of the surface from which they are dropped. Guttæ bear no relationship to the pharmacopœial minim.

The Relation of Measures of Capacity to the Metrical Measures.

1 Fluid drachm	=	3·55	cubic centimetres (c.c.).
1 Fluid ounce	=	28·397	,, ,,
1 Pint	=	567·932	,, ,,
1 Gallon	=	4·54	litres.

The Metric System of Weights and Measures.[1]—The "Metric System" is so called because all its measures and weights are derived from the French *mètre*, *i.e.*, have the French *mètre* for their basis. It comprises six different kinds of measures, but only three will be described in this work, viz.:—

1. The measure of Length, or linear measure, having for its unit the Metre.
2. The measure of Capacity (for liquids), having for its unit the Litre.
3. The measure of Mass, having for its unit the Gramme.

In each measure the higher denominations are derived from the unit by multiplication by ten, or some power of ten; the lower denominations being obtained by dividing the unit by ten, or some power of ten. Since the number ten (*decem*) is the only one employed to multiply and divide the units of measure, the system is called a "Decimal System."

The multiples are designated by prefixes derived from the Greek, and the submultiples from the Latin:—

Deca, signifying . .	10	Deci, signifying	$\frac{1}{10}$	= 0·1
Hecto, ,, . .	100	Centi, ,,	$\frac{1}{100}$	= 0·01
Kilo, ,, . .	1000	Milli, ,,	$\frac{1}{1000}$	= 0·001

These terms being prefixed to the several units—a kilometre = 1000 metres; a decilitre = the tenth part of a litre; a milligramme = the thousandth part of a gramme.

[1] The French government undertook, towards the end of the last century, to establish a uniform system for use in France, and in order to make it general foreign countries were invited to join. Spain, Belgium, Denmark, Tuscany, Switzerland, &c., sent representatives to assist in determining the new units; but their labours, which commenced on 31st March 1791, were interrupted by political events, and it was only seven years afterwards, on the 22nd of June 1799, that their operations were concluded. The Metric System was only legally established in France on 1st January 1840. If all nations could have agreed to use everywhere the same measures, it would have greatly simplified their commercial and industrial relations to each other, but, unfortunately, they have not done so; and as communications between different countries were at first difficult and slow, different measures have been established everywhere, even in different towns in the same country.

Measure of Length.—The metre was intended to be equal to the ten-millionth part of the distance between the poles and the equator, but it is really equal to the length of a rod of

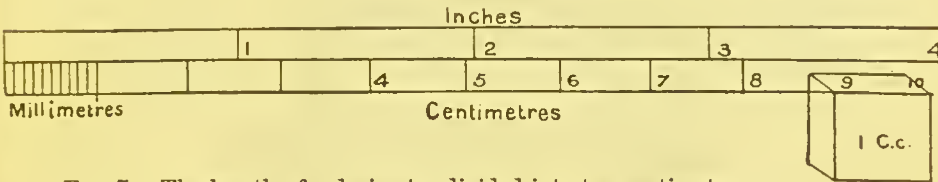


FIG. 7.—The length of a decimetre divided into ten centimetres.

platinum at 0° C. deposited in the archives of France on the 22nd of June 1799, at the same time with the prototype standards of weights. The model which represents the metre is divided into ten equal parts or *decimetres*, each of the latter being subdivided into ten equal parts or *centimetres*, and these again into ten equal parts called *millimetres.*

After having measured a length, if we find it to contain 4 decimetres and 5 centimetres, we should read it as 45 centimetres and write it as such, or as ·45 metre.

Measure of Capacity.—The litre, which is the unit of capacity, is equal to the cubic decimetre, or $10 \times 10 \times 10 =$ 1000 cubic centimetres.

Measure of Weight. — The unit of the measure of weight is the gramme, which is the weight of a cubic centimetre distilled water in its state of maximum density (4° C.), weighed

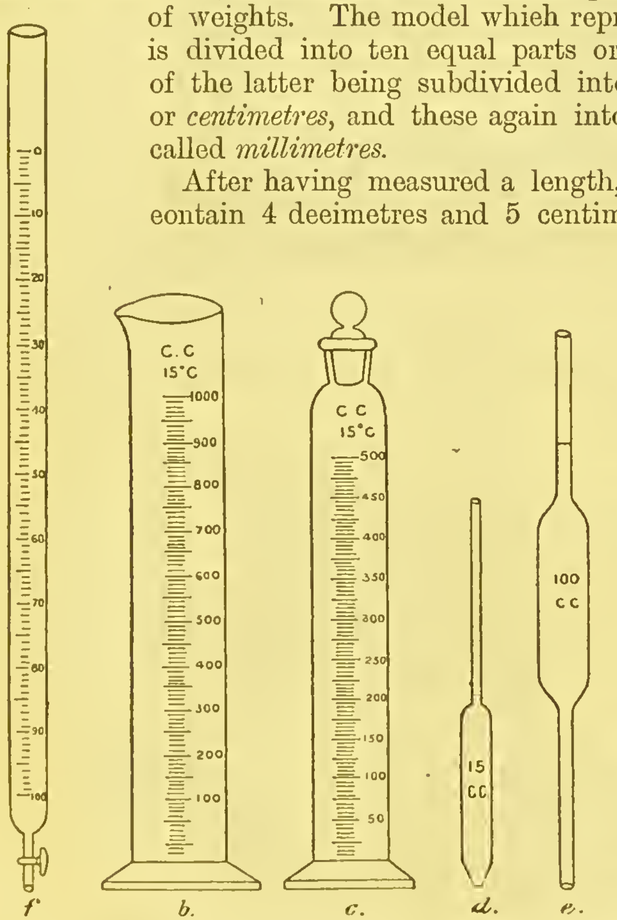


FIG. 8.—*b*, a litre measure; *c*, a half-litre jar; *d* and *e*, cubic centimetre pipettes; *f*, a 100 c.c. burette.

in a vacuum; consequently, a litre of distilled water weighs a kilogramme or 1000 grms.

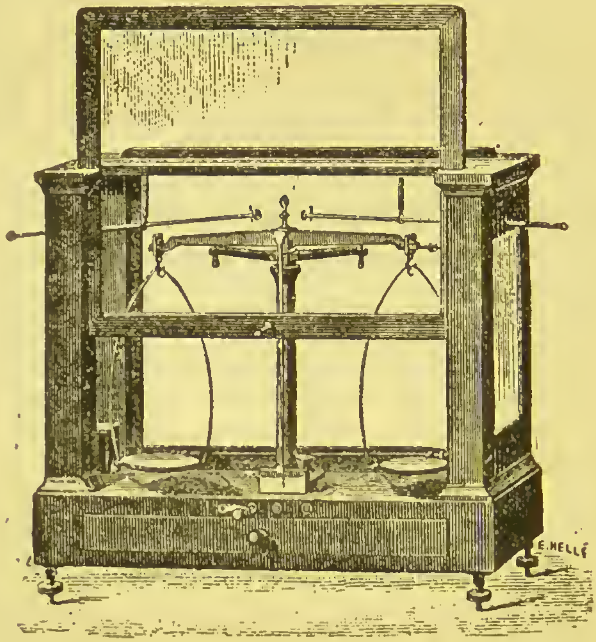


FIG. 9.—Delicate balance for analytical and other operations, to carry 50 grms. in each pan (6 cm. diameter) sensible to 0·0002 grm.

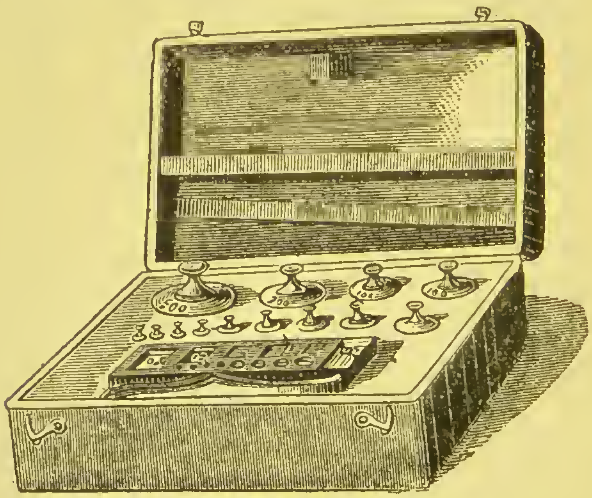


FIG. 10.—A set of gramme weights (in brass) from 500 grms. to 1 grm. The weights of the fractions of the gramme (in platinum foil) range from 0·5 to 0·001 grm.

(*a*) To find the area of a square or rectangle, multiply the length by the breadth.

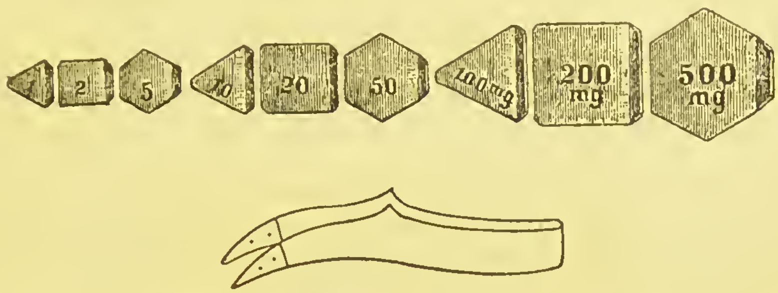


FIG. 11.—The platinum foil weights of fig. 10, and forceps wherewith to handle them (removed from the box).

(*b*) To find the area of a circle, multiply the square of the radius by 3·1416 (roughly $\frac{22}{7}$).

(*c*) To find the volume of a cylinder, multiply the area of the base by the height.

Metrical Weights and Measures and their British Equivalents.

1 Gramme	= 15·432 grains.
1 Cubic centimetre	= 17 minims.
1 Litre (1000 c.c.)	= 35·275 fluid ounces or 1·76 pints.
1 Metre	= 39·37 inches.
28·39 grms.	= 1 oz. avoird.
1 kilogramme	= 2·2 lb.

In dispensing medicines on the Continent (where the Metric System is generally adopted) all liquids and solids are prescribed and dispensed by weight—in grammes. Thus—

Potass. Bicarb.	15·0	= 15 grammes of Potassium Bicarbonate.
Tinct. Nucis. Vom.	0·75	= 75 centigrammes of Tincture of Nux Vomica.

Abbreviations.

Gramme	= *grm.* or *g.*
Metre	= *m.*
Centimetre	= *cm.*
Cubic centimetre	= *c.c.* or c^3 or cm^3.
Millimetre	= *mm.*
Micron	= ($\frac{1}{1000}$ *mm.*) = μ. [1]
Micromillimetre	= ($\frac{1}{1000000}$ *mm.*) = $\mu\mu$. [1]

[1] Microscopical measurements.

Density and Specific Gravity.[1]—By the "density" of a body is understood its *mass* or *quantity of matter*, compared with the mass or quantity of matter of an equal volume of some standard body arbitrarily chosen. "The specific gravity of a body is the relative weight of that body *as compared* with the weight of an equal volume of distilled water at 15°·5 C. (60° Fahr.); or, in other words, it is the relative density of equal bulks of matter, water being taken as the standard."

In scientific work it is usual to compare the density of the body when at 0° C., with water when at its point of maximum density (4° C.) taken as unity. When this is not done, the temperature of the water and of the body should be stated.

If we take two vessels of equal capacity, and fill the one with mercury and the other with water, we shall find that the one containing the mercury is heavier than the one filled with water. This characteristic difference between the two substances is known as a difference in their *specific gravities*. When we say that lead is heavier than wood, we mean that, bulk for bulk, the one substance is heavier than the other—that a cubic foot of lead weighs more than a cubic foot of wood.

In order, therefore, to determine the specific gravity of a solid or liquid body, it is necessary to determine its weight and that of an equal volume of water, and then to divide the first weight by the second: the quotient is the specific gravity of the body. Three methods are commonly used in determining the specific gravity of liquids and solids. These are—(1) the method of the hydrostatic balance, (2) that of the specific gravity flask, (3) the hydrometer. All three depend upon the same principle—that of first ascertaining the weight of a body, and then the weight of an equal volume of water. The manipulation adopted for finding the specific gravities of bodies of course varies according to the nature of the substance.

For accurate work it is requisite to use a delicate balance (an ordinary chemical balance) capable of showing a weight of 0·0002 grm., when loaded with 40 to 50 grms. in each pan. Most chemical balances are provided with a special short-slung brass or platinum pan with a hook at its bottom for the purpose of suspending solids therefrom during their determination; in using this pan, it is necessary to ensure equilibrium by the addition of weights or otherwise (sand, &c.) before commencing operations.

[1] The terms "density" and "specific gravity" are used synonymously in chemical literature without any practical inconvenience, since mass and weight are directly proportional.

Specific Gravity Bottle.—This is a glass-stoppered bottle with a narrow neck, made to hold a certain weight of water at the ordinary temperature 15°·5 C. (60° Fahr.), employed in the determination of the specific gravity of a liquid or a powder.

Of the numerous forms of specific gravity bottles, Regnault's is generally preferred as being most convenient and accurate, the usual sizes being adjusted to contain, when filled up to the point marked on the neck, 1000, 700, 500, and 250 grains of water respectively.

Whenever the liquid under determination can be obtained in sufficient quantity, the 1000-grain flask is the most convenient to use. To save time in the use of these instruments, they are generally furnished respectively with a brass counterpoise.

A 20-gramme flask is also a very convenient vessel.

FIG. 12.—A 1000-grain sp. gr. flask.

I. *To find the specific gravity of liquids to be had in large quantity, heavier or lighter than water.*—Counterpoise on a delicate balance the 1000-grain empty flask,[1] bring the temperature of liquid to 15°·5 C., fill the flask to the mark on the neck (in such a manner that the mark is on a level with the bottom of the meniscus), ascertain the weight of liquid, divide that weight in grains by 1000: the quotient equals the specific gravity of the liquid. If the 700, 500, or 250 grain flask were used, the weight of liquid divided by the respective number should, of course, give the same result. Thus, if the 1000-grain flask filled successively with sulphuric acid and rectified spirit weighed 1845 and 838 grains, their respective specific gravity would be $1845 \div 1000$ = sp. gr. 1·845, and $838 \div 1000$ = sp. gr. ·838.

Another method of almost equal accuracy is to weigh a conveniently shaped lump of glass (or a piece of aluminium) suspended from the hooked scale pan by a silk thread, first in air, then in water, and finally in the liquid the specific gravity of which is to be determined. Its loss of weight in the liquid divided by its

[1] In using the specific gravity bottle, not only must its absolute cleanliness be ensured, but, before introducing the liquid, it should also be perfectly *dry;* the latter may be ensured by first rinsing with rectified spirit, then with ether, and finally inserting a glass tube and *sucking out* the air until free from ethereal vapour.

loss of weight in water is the specific gravity of the liquid; the above method is in principle that of the hydrostatic balance.

Hydrometers (*q.v.*) are also used for taking the specific gravity of liquids; in this case, although the method is not so accurate, the use of the balance and flask is dispensed with.

II. *To take the specific gravity of a liquid to be had in small quantity.*—Proceed either by the method of the hydrostatic balance just referred to, or take a piece of ordinary glass tubing, and draw it out at both ends as a capillary, in such a manner as to leave about an inch of the original tube in the middle: cut away the extremities as shown in figure 13. The remaining middle portion constitutes, to all intents and purposes, a very small sp. gr. flask. In use (1) it must be duly counterpoised with weights; (2) then filled with water by suction or other mechanical contrivance, and weighed again, the difference being weight of water; (3) emptied, dried, and filled with the liquid the sp. gr. of which is required, and weighed again. Sp. gr. = weight of liquid divided by weight of water.

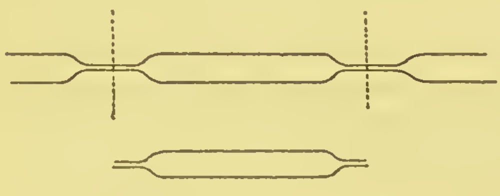


FIG. 13.

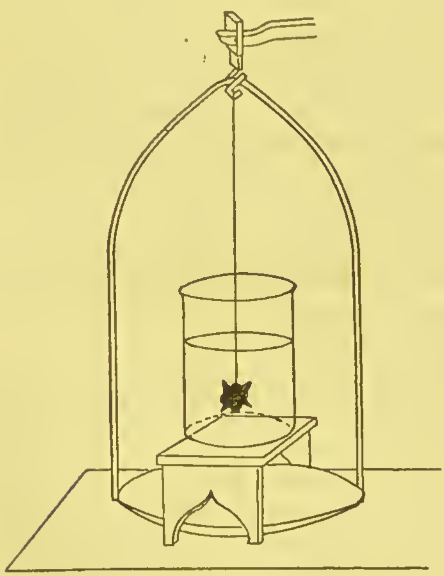


FIG. 14.—Sp. gr. of a solid.

III. (*a*) *To take the sp. gr. of a solid insoluble in water.*—Supposing the solid to be a piece of marble (fig. 14), (1) ascertain its weight in air = 1·398 grms.; (2) suspend by a thin fibre of silk, and ascertain its weight in water (weight of silk may be neglected), loss of weight = 0·597 grms.; (3) therefore, sp. gr. $= \frac{1·398}{·597}$, or 2·342.

(*b*) *To take the sp. gr. of a body lighter than water.*—This is accomplished by attaching the body to a substance of sufficient weight to sink it. Let the body be a piece of paraffin weighing in air 4·273 grms.; a piece of lead weighing in water, say, 7·596

grms. is stuck or attached to the paraffin, the two together weighing in water, say, 6·423 grms. Therefore, weight of paraffin in air 4·273 + weight of lead in water 7·596 − weight together 6·423 = 5·446.

$$\text{Sp. gr. of paraffin} = \frac{4{\cdot}273}{5{\cdot}446}, \text{ or } {\cdot}784.$$

IV. *To take the sp. gr. of a solid soluble in water.*—This is accomplished by weighing the solid in a liquid of known sp. gr. in which it is insoluble.

Let the solid be a piece of alum weighing 5·21 grms. ; the liquid, oil of turpentine, sp. gr. ·874.

Weight in turpentine = 3·702 grms.
Weight of turpentine displaced = 1·508 grms.

$$\text{Therefore, } \frac{1{\cdot}508}{{\cdot}874} = 1{\cdot}725 \text{ grms. of water displaced.}$$

$$\text{Therefore, } \frac{5{\cdot}21}{1{\cdot}725} = 3{\cdot}019 \text{ sp. gr. of alum.}$$

V. *To take the sp. gr. of a heavy powder insoluble in water.*—Using the 1000-grain sp. gr. flask, introduce, say, 150 grains or other weighed quantity of the insoluble powder, *e.g.*, sand. Introduce the sand into the empty flask, fill with water to the mark on the neck, and weigh the two together: weight = 1096 grains, the amount of water displaced is therefore 1150 − 1096 = 54 grains; therefore, $\frac{150}{54} = 2{\cdot}77$ sp. gr. of sand.

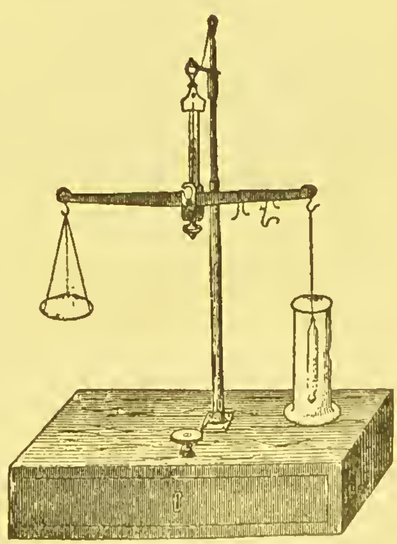


FIG. 15.—Hydrostatic balance.

The Hydrostatic Balance.—In this balance (fig. 15), made for readily ascertaining the specific gravities of liquids lighter and heavier than water (in the latter instance up to sp. gr. 2·0), one arm of the beam is divided into ten equal divisions (fig. 16), a glass plummet being suspended by a thin platinum wire from its extremity; from the other end of the beam is suspended an ordinary scale pan, the whole then being in equilibrium.

When the plummet is immersed in distilled water, that end of the beam of course rises; a piece of bent wire (termed a rider) is then cut of such dimension that when suspended from the hook

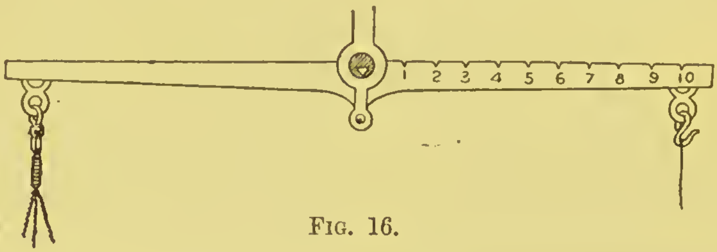


FIG. 16.

at the plummet end of the beam (or on the groove immediately over it) equilibrium is restored

This rider may be called *d* (fig. 17), and corresponds (when on the beam) to the weight of the water displaced by the plummet (it is useful to have an additional rider *d*). A second rider, *f*, of more slender wire, weighing $\frac{1}{10}$ of *d*, is then prepared, and one weighing $\frac{1}{100}$ of *d*, which may be designated *e*.

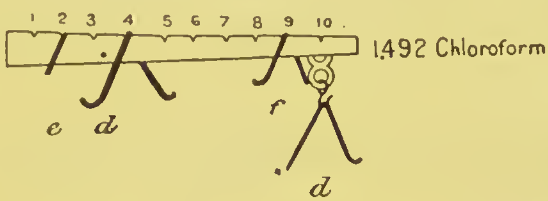


FIG. 17.

To find the specific gravity of a liquid, introduce into it the plummet, and arrange the riders on the beam in such a manner as to restore equilibrium (fig. 18).

The Hydrometer[1] is an instrument which, on being floated in a liquid, shows its specific gravity either by direct inspection or by simple adjustment and calculation.

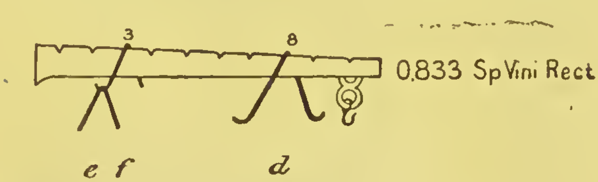


FIG. 18.

Its action depends upon the simple principle of hydrostatics that a floating body must displace its own weight of liquid. Instruments showing the specific gravity by direct inspection are generally of two kinds, the one for liquids lighter than water, such as alcohol (fig. 19), the other for liquids heavier than water (fig. 20). They are generally made of light glass tubes with bulbs blown in a single piece, so weighted with mercury, sealed, and adjusted, that the

[1] On the Continent generally called an *Areometer*.

instruments shall sink to a convenient depth, and are then graduated on the stem by trial in liquids of known specific gravity. A glass cylinder for floating the instruments is shown in fig. 21. Among the other kinds of these instruments, requiring the use of calculation tables, &c., which usually accompany them, are Sikes' hydrometer (used by the Excise for spirituous liquids), Beaumé's and Twaddle's—the graduation of each of which into *degrees* is conventional.

Alcoholometers, lactometers,[1] saccharometers, and urinometers are similar instruments specially graduated for examining alcohol,

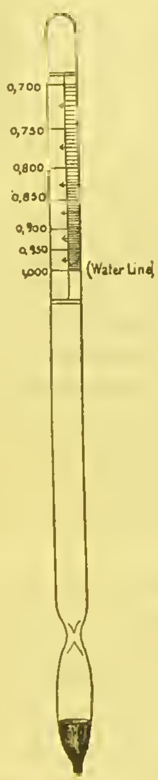


FIG. 19.

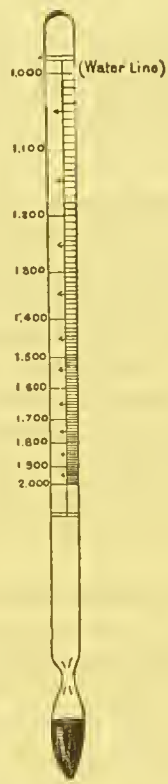


FIG. 20.

FIG. 21.

milk, sugar solutions, and urine respectively; although the results are not so accurate as those obtainable with the balance and flask, for practical purposes they are very useful.

[1] *Lactometer.*—The specific gravity of perfectly fresh unskimmed milk being between 1·025 and 1·030 (after the cream has risen to the surface it is naturally higher), the degrees of a lactometer range between 1000–1040. *Urinometer.*—The specific gravity of normal urine being 1·020 (1018–1025), urinometers range between 1000–1040.

A Short Table of Important Specific Gravities.

Acidum Hydrocyanicum Dil.,	·997
„ Nitricum,	1·42
„ Sulphuricum,	1·843
Æther,	·735
„ Purus,	·720
Alcohol Amylicum,	·818
„ Ethylicum (*Absolute Alcohol*),	·797 to ·800
Chloroformum,	1·497
Glycerinum,	1·25
Spiritus Ætheris Nitrosi,	·840 to ·845
„ Ammoniæ Aromaticus,	·886
„ Rectificatus (Rectified Spirit),	·838
„ Tenuior (Proof Spirit),	·920
Syrupus,	1·330

Thermometers.—Thermometers are instruments for measuring temperatures, *liquids* being best suited for their construction—the expansion of solids being too small, and that of gases too great. Mercury and alcohol are the only liquids used—the former because it remains liquid at a very high temperature, and the latter because it does not solidify at an exceedingly low temperature.

The mercurial thermometer is the most extensively used. It consists of a capillary glass tube, at the end of which is blown a *bulb*, a cylindrical or spherical reservoir. Both the bulb and a part of the stem are filled with mercury, and the expansion is measured by a scale graduated either on the stem itself, or on a frame to which it is attached.

Construction of the Mercurial Thermometer.—A piece of glass tube of uniform capillary bore open at each end is selected, one end is then sealed in the Bunsen flame, and blown into a cylindrical, or spherical, shaped bulb; the bulb on being heated *over* the flame, then removed, and the open end immediately plunged beneath the surface of pure mercury, upon cooling, sucks up the mercury by the contraction of the air within. Having by this means got some mercury into the bulb, the latter is heated until the mercury boils (whereby the remaining air is removed); the open end is plunged under mercury as before, and when filled, the open end is hermetically sealed in the flame. Upon cooling, the mercury will contract into the bulb, leaving a vacuum in the greater portion of the capillary tube. The next operation is to graduate the instrument by determining two fixed points upon it (the freezing and boiling points of water) and the division of the intermediate space into equal parts termed "degrees." The "freezing-

point" is determined by allowing the instrument to remain in melting ice for about twenty minutes, the "boiling-point" by completely immersing it in the steam arising from pure water boiling at the standard pressure of the atmosphere, viz., 760 millimetres. Upon the *Centigrade* or *Celsius* scale the points ascertained are marked 0° (zero) and 100° respectively: the Centigrade thermometer (fig. 22) is almost exclusively adopted in all scientific literature. Upon the *Fahrenheit* scale, still much used in England, the 0° or zero denotes a much lower temperature, at that time (1714) erroneously considered to represent absolute cold (obtained by immersion in a mixture of equal weights of sal-ammoniac and snow), the space intermediate between that and the boiling-point of water being divided into 212°; of such, 32° represents the freezing-point of water.

In *Réaumur's* scale, the fixed points are the same as on the Centigrade scale, except that the intermediate space is divided into 80 parts instead of 100.

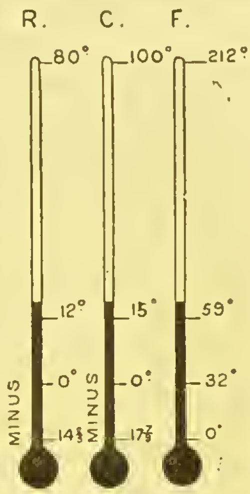


FIG. 22.

The space below zero in either thermometer is likewise graduated, such degrees being represented with a *minus* sign (*e.g.*, – 10° C.).

To reduce degrees Centigrade to Fahrenheit.—Multiply by 9, divide by 5, and add 32. *Example.*—Convert 45° C. into degrees F. As—

$$5 : 9 :: 45 : x = 81$$
$$81 + 32 = 113° \text{ F.—Ans.}$$

To reduce degrees Fahrenheit to Centigrade.—Subtract 32, multiply by 5, and divide by 9. *Example.*—Convert 86° F. to Centigrade.

$$86 - 32 = 54. \quad \text{As } 9 : 5 :: 54 : x = 30° \text{ C.—Ans.}$$

Example.—Convert – 40° C. into Fahrenheit. As—

$$100 : 180 :: -40 : x = -72$$
$$-72 + 32 = -40° \text{ F.—Ans.}$$

(*A Table showing the comparison between the Scales of the Centigrade, Fahrenheit, and Réaumur Thermometers will be found in the Appendix.*)

PART I.

CHEMICAL PHARMACY.[1]

Table of Symbols and Atomic Weights of the Elementary Bodies mentioned in the British Pharmacopœia.

Elementary Bodies.	Quantivalence.	Symbols and Atomic Weights.
Aluminium,	IV.	Al = 27
Antimony (Stibium),	III., V.	Sb = 120
Arsenium,	III., V.	As = 75
Barium,	II.	Ba = 137
Bismuth,	III., V.	Bi = 209
Boron,	III.	B = 11
Bromine,	I.	Br = 80
Calcium,	II.	Ca = 40
Carbon,	II., IV.	C = 12
Cerium,	III., VI.	Ce = 141
Chlorine,	I.	Cl = 35·5
Chromium,	VI.	Cr = 52·5
Copper (Cuprum),	II.	Cu = 63·4
Gold (Aurum),	III.	Au = 196·5
Hydrogen,	I.	H = 1
Iodine,	I.	I = 127
Iron (Ferrum),	II., VI.	Fe = 56
Lead (Plumbum),	II., IV.	Pb = 207
Lithium,	I.	L = 7
Magnesium,	II.	Mg = 24
Manganese,	II., IV., VI.	Mn = 55
Mercury (Hydrargyrum),	II.	Hg = 200
Nitrogen,	III., V.	N = 14
Oxygen,	II.	O = 16
Phosphorus,	III., V.	P = 31
Platinum,	IV.	Pt = 195
Potassium (Kalium),	I.	K = 39
Silver (Argentum),	I.	Ag = 108
Sodium (Natrium),	I.	Na = 23
Sulphur,	II., IV., VI.	S = 32
Tin (Stannum),	II., IV.	Sn = 118
Zinc,	II.	Zn = 65

[1] A general knowledge of Chemistry, Chemical Physics, and Chemical Laboratory practice on the part of the student is presupposed (for scope of such, see Synopses in *Appendix*). The book of reference throughout this course is the *British Pharmacopœia*.

Chemical Nomenclature refers to the proper adjustment of the most convenient system of scientific names given to substancœs pertaining to the study of chemistry. The chemical name of a substance is designed not only to identify and particularise that substance, but also, where possible, to designate its composition and constitution.

Of Elements.—The method adopted in respect to the *metals* has been to Latinise them with the termination *ium* (*e.g.*, calcium, sodium, potassium, &c.). Certain metals, however, such as gold, silver, copper, and iron, from long established usage, retain their familiar names. In reference to the *non-metals*, those of the electro-negative halogen group terminate in *ine*, viz., fluorine, chlorine, bromine, iodine; four terminate in *on*, viz., carbon, silicon, boron, and selenion; thrce in *gen*, viz., oxygen, hydrogen, and nitrogen, from the Greek *genesis*, signifying the property these elements were formerly supposed to possess of generating respectively acid, water, and nitre.

Of Compounds.—In assigning names to binary inorganic compounds the electro-positive constituent (the metal) retains its termination in *ium*, the termination of the electro-negative constituent being changed into *ide*—thus

The compound	formed	with	Potassium	and	Iodine	is termed	Potassium Iodide.
,,	,,	,,	Sodium	,,	Chlorine	,,	Sodium Chloride.
,,	,,	,,	Calcium	,,	Oxygen	,,	Calcium Oxide.
,,	,,	,,	Barium	,,	,,	,,	Barium Oxide.

When the same clement forms two definite compounds with another element, the compound containing the larger proportion of the electro-negative constituent is designated by changing the *ium* or *um* of the positive element into *ic*; that containing the lesser amount by changing the positive termination into *ous*. Tin forms two such compounds with chlorine, known as *stannic chloride* ($SnCl_4$) and *stannous chloride* ($SnCl_2$) respectively. This rule applies also to the compounds known as anhydrides, *e.g.*, N_2O_5, *nitric anhydride*, and N_2O_3, *nitrous anhydride*.

Anhydride.—This term is applied to compounds containing *oxygen*, which when treated with water form an *acid*, or with a base form a *salt*: thus a molecule of nitric anhydride, N_2O_5, *plus* a molecule of water, H_2O, combine to form two molecules of nitric acid, $2HNO_3$. In other words, an anhydride is an acid *minus* the elements of water. Two are pharmacopœial, viz., As_2O_3 and CrO_3, for convenience designated *Acidum arseniosum* and *Acidum chromicum* respcctively.

Of Acids.—An acid is a compound containing one or more

atoms of hydrogen, which may be replaced by a metal when the latter is presented to it in the form of a hydrate. Acids containing one atom of replaceable hydrogen are termed *monobasic*, two atoms *dibasic*, &c.; they are generally soluble in water, possess a sour taste, redden blue vegetable pigments such as litmus, and are neutralised by alkalis and bases. Oxy-acids (acids containing oxygen), the names of which terminate in *ic*, form salts terminating in *ate;* acids terminating in *ous* form salts terminating in *ite.*

Thus, sulphur*ic* acid forms with potassium hydrate the salt called potassium sulph*ate.* Nitrous acid with potassium hydrate would form the salt potassium nitr*ite.*

A group of different atoms in a compound which performs the functions of an element is termed a *compound radical.* Thus in the equation $H_2\overline{SO_4} + 2KHO = K_2\overline{SO_4} + 2H_2O$, the SO_4 group is termed the "sulphuric acid" radical, and necessarily enters into the composition of all sulphates.

Basicity of the Acids.

Monobasic.

Acetic acid, . .	$HC_2H_3O_2$	yielding salts	termed	Acetates.
Benzoic „ . .	$HC_7H_5O_2$	„	„	Benzoates.
Bromic „ . .	$HBrO_3$	„	„	Bromates.
Carbolic (Phenic) acid,	HC_6H_5O	„	„	Carbolates.
Chloric „	$HClO_3$	„	„	Chlorates.
Cyanic „	$HCyO$	„	„	Cyanates.
Hydriodic „	HI	„	„	Iodides.
Hydrobromic „	HBr	„	„	Bromides.
Hydrochloric „	HCl	„	„	Chlorides.
Hydrocyanic „	HCy	„	„	Cyanides.
Hydrofluoric „	HF	„	„	Fluorides.
Hypochlorous „	$HClO$	„	„	Hypochlorites.
Hypophosphorous „	HPH_2O_2	„	„	Hypophosphites.
Iodic „	HIO_3	„	„	Iodates.
Metaboric „	HBO_2	„	„	Metaborates.
Metaphosphoric „	HPO_3	„	„	Metaphosphates.
Nitric „	HNO_3	„	„	Nitrates.
Nitrous „	HNO_2	„	„	Nitrites.
Oleic „	$HC_{18}H_{33}O_2$	„	„	Oleates.
Perchloric „	$HClO_4$	„	„	Perchlorates.
Salicylic „	$HC_7H_5O_3$	„	„	Salicylates.
Sulphocarbolic „	$HC_6H_5SO_4$	„	„	Sulphocarbolates.
Sulphocyanic „	$HCyS$	„	„	Sulphocyanides.
Valerianic „	$HC_5H_9O_2$	„	„	Valerianates.

Dibasic.

Carbonic acid, . .	H_2CO_3	yielding salts	termed	Carbonates.
Chromic „ . .	H_2CrO_4	„	„	Chromates.
Dithionic „ . .	$H_2S_2O_6$	„	„	Dithionates.
Hydrosulphuric acid,	H_2S	„	„	Sulphides.
Hyposulphurous „	$H_2S_2O_3$	„	„	Hyposulphites.
Lactic „	$H_2C_3H_4O_3$	„	„	Lactates.
Manganic „	H_2MnO_4	„	„	Manganates.
Meconic „	$H_2C_7H_2O_7$	„	„	Meconates.
Oxalic „	$H_2C_2O_4,2H_2O$	„	„	Oxalates.
Permanganic „	$H_2Mn_2O_8$	„	„	Permanganates.
Phosphorous „	H_2PHO_3	„	„	Phosphites.
Sulphuric „	H_2SO_4	„	„	Sulphates.
Sulphurous „	H_2SO_3	„	„	Sulphites.
Tartaric „	$H_2C_4H_4O_6$	„	„	Tartrates.

Tribasic.

Arsenic acid,	H_3AsO_4	„	„	Arseniates.
Arsenious acid,	H_3AsO_3	„	„	Arsenites.
Boric (Boracic) acid,	H_3BO_3	„	„	Borates.
Citric „	$H_3C_6H_5O_7$	„	„	Citrates.
Gallic „	$H_3C_7H_3O_5,H_2O$	„	„	Gallates.
Phosphoric „	H_3PO_4	„	„	Phosphates.
Tannic „ (?)	$C_{27}H_{22}O_{17}$	„	„	Tannates.

Tetrabasic.

Hydroferrocyanic acid	H_4FeCy_6	„	„	Hydroferrocyanides.
Pyrophosphoric „	$H_4P_2O_7$	„	„	Pyrophosphates.
Silicic „	H_4SiO_4	„	„	Silicates.

Hexabasic.

Hydroferricyanic acid	$H_6Fe_2Cy_{12}$	„	„	Ferricyanide.

Formulæ of Salts (*Theoretical*).

	Monad or Univalent Metals, *e.g.*, Potassium.	Dyad or Bivalent Metals, *e.g.*, Calcium.	Triad or Trivalent Metals, *e.g.*, Gold.	Tetrad or Quadrivalent Metals, *e.g.*, Platinum.
With monobasic acids, *e.g.*, HCl	KCl	$CaCl_2$	$AuCl_3$	$PtCl_4$
„ dibasic „ „ H_2SO_4	K_2SO_4	$CaSO_4$	Au_23SO_4	$Pt2SO_4$
„ tribasic „ „ H_3AsO_3	K_3AsO_3	Ca_32AsO_3	$AuAsO_3$	Pt_34AsO_3
„ tetrabasic „ „ H_4SiO_4	K_4SiO_4	Ca_2SiO_4	Au_43SiO_4	$PtSiO_4$

Of Bases.—A base is a compound which is converted into a salt by the action of an acid. Bases may be divided into three classes, viz., metallic oxides, *e.g.*, K_2O, Na_2O, FeO; metallic hydrates, *e.g.*, $NaHO$, KHO, $Zn(HO)_2$; some compounds of nitrogen, hydrogen, phosphorus, arsenic, and antimony, *e.g.*, ammonia NH_3, alkaloids (organic bases).[1] Bases soluble in water generally possess *alkaline* properties, and change the colour of reddened litmus to blue (acids rechanging blue to red).

Of Salts.—Salts are the compounds produced by the action of an acid on a base; when containing oxygen, they are termed *oxysalts;* if the oxygen be replaced by sulphur, *sulpho*salts; if free from oxygen and sulphur, *haloid* salts.

Salts are either normal, acid, or basic. A *normal* salt is one in which the whole of the replaceable hydrogen of the acid has been replaced with an equivalent amount of the metal or compound radical. An *acid* salt is one in which only a portion of the displaceable hydrogen has been so replaced. A salt is called *basic* when the amount of the metal or compound radical is in excess of the amount of displaceable hydrogen in an acid.

Organic bases (alkaloids) terminate, it has been stated, in *ine* (Lat. *ina*), *e.g.*, *quinina* (Lat.) = quinine; *morphinæ acetas* = morphine acetate. (Organic glucosides and neutral principles of plants, and certain proteids, terminate in *in* (Lat. *inum*), *e.g.*, *digitalinum* (Lat.) = digitalin; *santoninum* (Lat.) = santonin; albumin.)

Salts which have no colouring action on litmus-paper are said to be *neutral;* such generally possess a saline taste, *e.g.*, ammonium chloride, potassium nitrate, sodium nitrate, sodium sulphate, magnesium sulphate, calcium sulphate, barium nitrate. Many of the soluble sulphates and nitrates, however, are *acid* to test-paper, *e.g.*, ferrous sulphate, zinc sulphate, manganous sulphate, copper sulphate. Others, again, such as potassium carbonate, sodium carbonate, and borax, possess decidedly *alkaline* properties.

The following terms, owing to their long-established use in medical literature, and frequent occurrence in physicians' prescriptions, deserve mention; they constitute prefixes to the electro-negative element: thus *hypo*, *proto*, or *sub*[2] are used to designate the compound containing the less amount of the negative element (*e.g.*, ferrous oxide, FeO, is sometimes termed *protoxide* or *monoxide of iron*, mercurous chloride, $HgCl$, is termed *subchloride of mercury*). To distinguish the compounds richest in the amount

[1] These organic bases terminate in *ine* (Latin *ina*), *e.g.*, Lat. *quinina* = quinine; nitrine (NH_3), however, retains its popular name "ammonia."

[2] Greek *hypo*, under; *proto*, first; Latin *sub*, under.

of negative or chlorous constituent, the affixes *sesqui* and *per*[1] are used (*e.g.*, ferric oxide, Fe_2O_3, is termed *peroxide* or *sesquioxide of iron*, mercuric chloride, $HgCl_2$, *perchloride of mercury*).

Of Double Salts.—A salt containing two bases associated with one acidulous radical is termed a *double salt;* the base, ammonia, possesses a remarkable tendency to form these compounds, *e.g.*, the yellow crystals of double chloride of ammonium and platinum ($2NH_4Cl,PtCl_4$). The double *sulphates* formed by the metals aluminium, chromium, iron, manganese, with either potassium, sodium, or ammonium, are temed *alums.*

An oxidising agent is a substance which, under suitable conditions, parts with its oxygen. The following are the most common oxidisers:—Nitric acid (as in the preparation of *Acid. Phosphoricum Conc.; Hydrarg. Ox. Rubr.*) and nitrates, chloric acid and chlorates, chlorine in presence of moisture, hypochlorous acid and hypochlorites, air and oxygen gas, bichromate of potassium, manganic oxide, permanganate of potassium, &c.

A reducing or deoxidising agent is a substance which tends to remove oxygen from bodies. The following are the most common —Carbon (*e.g.*, preparation of *Acid. Sulphurosum*) and hydrogen (*e.g.*, *Ferrum Redactum*) at high temperatures, nascent hydrogen, sulphurous acid and sulphites, sulphuretted hydrogen (*e.g.*, *Acid. Hydrobrom. Dil.*), hyposulphites, arsenious anhydride, ferrous and stannous salts, potassium and sodium, &c.

Analysis.—The separation of a compound body either into its proximate[2] or elementary constituents by means of various solvents and reagents is termed *analysis.*

Qualitative analysis is that branch of practical chemistry which has for its object the determination of the elementary constituents of a body and the methods of their identification and separation: for example, by qualitative analysis, the mineral known as "arsenical pyrites" is proved to be a compound of iron, arsenium, and sulphur.

Quantitative analysis treats of the processes whereby the *relative amounts* of the constituents of a body may be determined.

The subject of quantitative analysis, in practice necessarily preceded by qualitative, is divided under two methods, gravimetric analysis and volumetric analysis: *gravimetric estimations*

[1] Latin *sesqui*, one and a half; *hyper*, over, exceeding.

[2] The term "proximate" is applied generally to constituents of organic origin—for example, the proximate constituents of rhubarb-root are various organic acids, resins, glucosides, albumin, water, cellulose, and mineral salts.

are effected in the dry way by *weighing* the respective constituent elements in the form of some combination, the exact composition of which is accurately known, and from which the amount can thus be readily calculated; *volumetric estimations* are conducted in the wet way by means of reagents (standard solutions), the strength of which is accurately known, the amount of the reacting constituent being calculated from the measure or *volume* of the standard solution used.

As regards the quantitative analysis of the *carbon compounds* (including *animal and vegetable* substances), it is either proximate or ultimate, *proximate analysis* pertaining to the extraction, isolation, and determination of definite proximate constituents (*e.g.*, water, ash, essential and fixed oils, resin, acids, alkaloids, glucosides, gum, &c.); *ultimate* to the estimation of the amount of carbon, oxygen, hydrogen, nitrogen, or other elements contained in a proximate principle, or other carbon compound.

Synthesis.—Synthesis, as opposed to analysis, is the process of building up a compound by the union of its elements.

Vaporisation is the conversion of a liquid into a gas or vapour. It sometimes takes place quietly without the formation of bubbles in the body of the liquid, and sometimes in a violent manner with the formation of bubbles. In the former case it is termed "evaporation," in the latter "ebullition."

Ebullition may be, therefore, defined as the formation, in any liquid submitted to heat, of bubbles of vapour, of an elasticity equal to that of the superincumbent atmosphere at the time; at ordinary atmospheric pressure (760 mm.), the point at which ebullition commences, is called the "boiling-point."

Æther boils at	34°·2 C.
Alcohol ,, ...	78°·4 C.
Water ,, ...	100°·0 C.
Acidum Sulphuricum boils at .	325°·0 C.
Hydrargyrum ,, .	350°·0 C.

Distillation.—Distillation is the conversion of a liquid into vapour, and its recondensation into the liquid form, called the distillate, in another vessel. The object of distillation is generally to separate volatile liquids from less or non-volatile substances with which they may be associated. Upon the large scale, as in the distillation of alcohol from fermented saccharine liquids, the latter are heated in a copper vessel, A, termed a "still," and the vapour issuing therefrom is made to pass through a coil of pipes (termed a "worm") surrounded with cold water, thereby

becoming condensed to a liquid—collected in a vessel termed the "receiver," B (fig. 23).

In small laboratory operations the liquid to be distilled is heated in a flask, and the vapour made to pass through a Liebig's

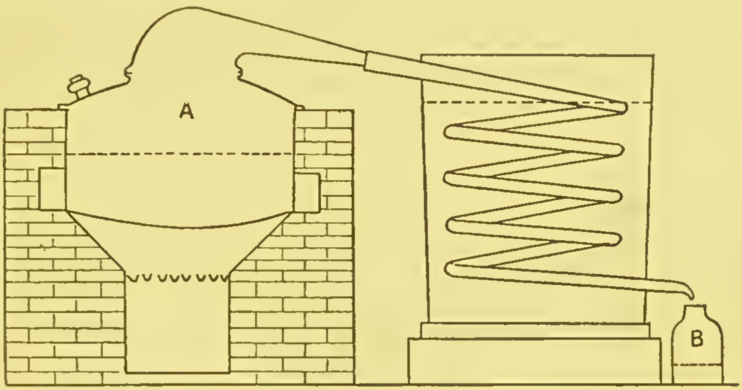


FIG. 23.—Apparatus for distillation. A, still; B, receiver.

condenser (fig. 24)—the latter consisting of a long glass tube fitted within a larger tube in such a manner that a constant supply of cold water is capable of being passed through the intervening space. Inflammable liquids of low boiling-points should be distilled over a water-bath, by which means, together with a thermometer inserted in the neck of the flask, the application of heat may be better regulated (fig. 25).

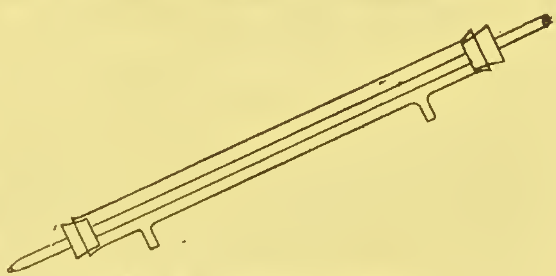


FIG. 24.—Liebig's condenser.

Distilled Water.—For the preparation of pure water for manufacturing and laboratory purposes, the process of distillation is resorted to. Ordinary water free from odour, unusual taste, and visible impurity, the purest that can be obtained, is placed in a vessel raised to the boiling-point by the application of heat, and the issuing steam passed through a cooled condenser, and collected as water in another vessel. The precautions to be taken are:—To use perfectly clean apparatus; to reject the portion[1] which first distils over since it may contain ammonia, carbonic

[1] Corresponding to about $\frac{1}{20}$th of the volume placed in the still.

acid, and other volatile impurities; to stop the process when about three-fourths have been collected.[1]

Distilled water thus obtained is a colourless liquid, without odour or taste, exerts no action on test-papers, and, when evaporated to dryness, leaves no residue.

Natural Waters.—Of natural waters, *rain-water* is evidently the purest form; it contains in solution, however, the elements of atmospheric air to the extent of about 3 to 4 per cent. by volume,

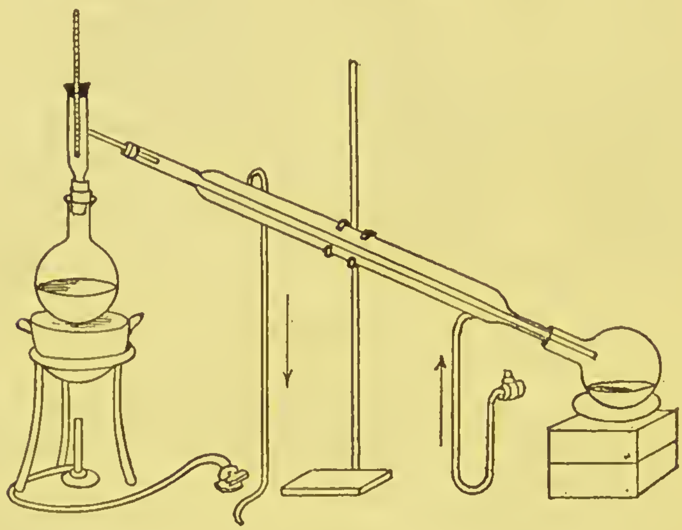


FIG. 25.—Distillation over a water-bath.

together with traces probably of ammonium nitrite and nitrate, and solid particles removed from the atmosphere. Although rain-water exercises a solvent action upon the soils and rocks with which it comes in contact, yet lake and river waters are, as a rule, less impregnated with mineral matter, as compared with waters which have traversed the lower mineral strata (spring-water). The kind of mineral matter found in spring-water varies, of course, with the composition of the strata it has traversed. That coming from the chalk formation contains chiefly calcium carbonate (held in solution by the carbonic acid gas dissolved in the water) causing *hardness*—hence, upon boiling, the calcium carbonate is precipitated, such waters being termed *temporarily hard.* Waters containing gypsum (calcium sulphate) in solution are described as being *permanently hard*, since calcium sulphate is not completely removed upon boiling. Potable waters should not contain in

[1] The remaining portion is not distilled lest any organic impurity should be decomposed, yielding a contamination of various volatile products.

solution more than a few grains of mineral matter per gallon, and should be free from any decomposable organic matter. Nitrites and nitrates are among the products of the oxidation of organic matter.

Waters impregnated with a large percentage of mineral matter are known as *mineral waters*, those containing iron being known as *chalybeate*, sulphuretted hydrogen, *sulphurous* or *hepatic*,[1] &c.

Distilled Water a Reagent.—The student should bear in mind the fact that distilled water constitutes in itself a reagent (see the testing of *Bismuthi Subnitras*, Ph.B.).

Tests for Distilled Water.—A fluid ounce of it evaporated in a clean glass capsule should leave no residue.[2] It is not affected by sulphuretted hydrogen,[3] oxalate of ammonium,[4] nitrate of silver,[5] chloride of barium,[6] solution of lime,[7] or a mixture of dilute acid, starch mucilage and iodide of potassium. It gives only a faint yellow coloration when a solution of potassio-mercuric iodide is added to three or four ounces.[8]

Compounds prepared by Distillation.—Among others, the following pharmacopœial compounds are prepared by distillation :—

Acidum Hydrobromicum.	*Amyl Nitris.*	
„ *Hydrochloricum.*	*Alcohol Amylicum.*	
„ *Hydrocyanicum Dil.*	*Spiritus Rectificatus.*	
„ *Nitricum.*	„ *Ætheris Nitrosi.*	*Galenical.*
„ *Valerianicum.*	„ *Ammoniæ Aromaticus.*	
Æther.	„ *Armoraciæ Compositus.*	
Chloroform.	*Aquæ.*	
Æther Aceticus.		

Fractional distillation is that modification of the process whereby, with the proper regulation of heat, mixed liquids of different boiling-points are separated from one another (*e.g.*, *Butyl-chloral ; Ac. Carbolicum*).

Destructive distillation is the resolution of a complex substance into simpler forms under the influence of heat out of contact with air ; the operation is generally performed in cylinders of cast-iron, *e.g.*, the preparation of coal-gas, *Acidum Aceticum*, *Creasotum*, and *Pix liquida.*

[1] For a good list of English and foreign mineral waters, with their characteristic constituents, see *Squire's Companion to the British Pharmacopœia* (Churchill).

[2] Showing absence of fixed salts. [3] Lead. [4] Lime salts.

[5] Chlorides. [6] Sulphates. [7] Carbonic acid.

[8] "Nessler's test" for "ammonia." Yellow colour is due to formation probably of tetramercurammonium iodide, Hg_2NI. The previous test, potassium iodide and starch, is for nitrites—among the decomposition products of organic matter.

Carbo Animalis and *Carbo Ligni* are residues of destructive distillation.

Sublimation consists of the conversion of a solid into vapour, and its recondensation to the solid condition. Massive sublimates (*e.g.*, *Ammonii Chloridum* and *Hydrargyri Perchloridum* as met with in pharmacy) are obtained (fig. 26) by condensation on a surface not much below the temperature of the vapour, pulverulent sublimates (*Hydrargyri Subchloridum* and *Sulphur*) by condensation in a cold atmosphere, effected by passing the vapour into a spacious cool chamber. *Acidum Benzoicum*, *Acid. Arseniosum*, *Ammonii Carbonas*, *Iodine*, and *Pyrogallic Acid* are also prepared by sublimation. *Camphor* is purified by this process.

Calcination (from Lat. *calx*, lime). By this term is understood the operation of heating mineral substances to a low red heat (*i.e.*, to ignition), whereby vaporisable constituents may be expelled; the process of "lime-burning" is a typical example, $CaCO_3 = CaO + CO_2$; calcined products are generally left in a friable condition. *Magnesia* and *Zinci Oxidum* are thus prepared, viz., by the ignition of their respective carbonates; the laboratory operation may be conducted in a Hessian crucible and furnace.

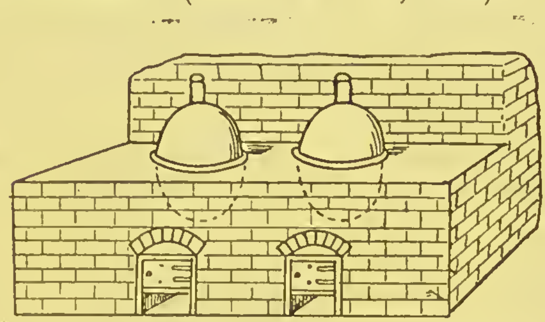


FIG. 26.—Apparatus for sublimation (after Pereira).

Solution.—Some solids, when brought in contact with certain liquids, disappear, forming with the liquid a homogeneous product: the solid is then said to dissolve, the dissolving liquid is termed the solvent, and the product is termed a solution. Solution is consequently facilitated by anything which diminishes the cohesive force of a solid, as, for instance, by previously reducing a substance to a fine powder it dissolves more rapidly; hence, also, the application of heat in effecting solution.[1] When a solid ceases to dissolve, the liquid is said to be *saturated.* When solids possess certain constitutional properties in common with the solvent, solution will, as a rule, be the more readily effected; for instance, mercury forms amalgams with many metals, alcohol and ether dissolve resins, and oils dissolve fats, waxes, and other allied bodies. Simple

[1] Lime and some of its salts constitute notable exceptions, they being nearly twice as soluble in water at 0° C. as at the boiling-point.

A Short Table of Solubilities.

One Part is Soluble in	Parts of (at 15° C.)		
	Water.	Alcohol, ·838.	Ether.
Acidum arseniosum, . .	100	...	...
„ boricum, . . .	30	20	...
„ salicylicum, . .	600	...	...
Alumen, ...	12	...	...
Ammonii chloridum, . .	4	...	...
Atropinæ sulphas, . .	1	3	...
Borax, ...	18	...	...
Bromum, ...	40	...	...
Cinchoninæ sulphas, . .	100	...	...
Codeina, ...	80	...	...
Creasotum, ...	100	...	...
Ferri sulphas, ...	2	...	...
Hydrargyri perchloridum, .	20	3	4
Iodum, ...	5000	10	3
Magnesii sulphas, . . .	1	...	...
Morphina, ...	1500	...	...
Morphinæ acetas, . . .	20	...	...
„ hydrochloras, .	25	50	...
„ sulphas, . .	20	...	...
Potassii bicarbonas, . .	4	...	...
Physostigminæ salicylas, .	150	12	...
Plumbi acetas, ...	3	30	...
Quininæ sulphas, . . .	800	...	...
„ bisulphas, . .	12	...	...
Saccharum, ...	0·5	...	...
„ lactis, . . .	7	...	...
Salicinum, ...	25	...	...
Santoninum, ...	5000	50	...
Strychnina, ...	800	...	...
Strychninæ acetas, . .	100	...	...
„ nitras, . .	100	100	...
„ sulphas, . .	75	...	...
Sodii bicarbonas, . . .	15	...	...
„ chloridum, . . .	3	...	...
Thymol, ...	1200	...	...
Zinci sulphas, ...	1	...	...
„ sulphocarbolas, . .	2	2	...
„ valerianas, . . .	100	...	...

solution of solids is attended with depression of temperature; but, should any chemical combination take place, there will be a development of heat. Saturated solutions of a salt are in some instances capable of exerting a solvent action upon other salts.

Certain gases are extremely soluble in water, *e.g.*, ammonia (*Liq. Ammoniæ Fort.*). The following are also solutions of their respective gases in water, viz., *Acidum Hydrochloricum; Ac. Sulphurosum; Liquor Chlori.*

Filtration is the operation involved in the separation of solid particles (*e.g.*, precipitates, &c.) from fluids, by passing the latter through some permeable medium obstructive to the passage of the solid particles. "Filter-paper" is generally used, but where inadmissible—asbestos, sand, or glass-wool. "Straining" has reference to the separation of coarser particles only, generally effected by such media as calico, flannel, and muslin. A method frequently resorted to in dispensary work for straining infusions and decoctions and other extemporaneous preparations, consists in pouring the liquid through an ordinary funnel loosely plugged with tow.

FIG. 27.—A ribbed funnel.

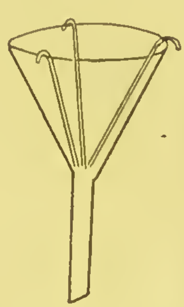


FIG. 28.—A smooth glass funnel, with glass rods (slightly hooked by heating in a flame) inserted to expedite filtration.

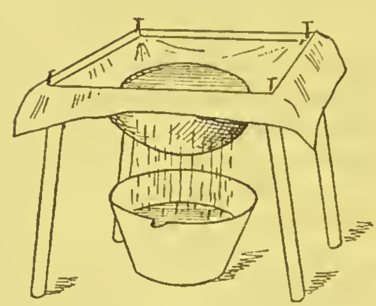
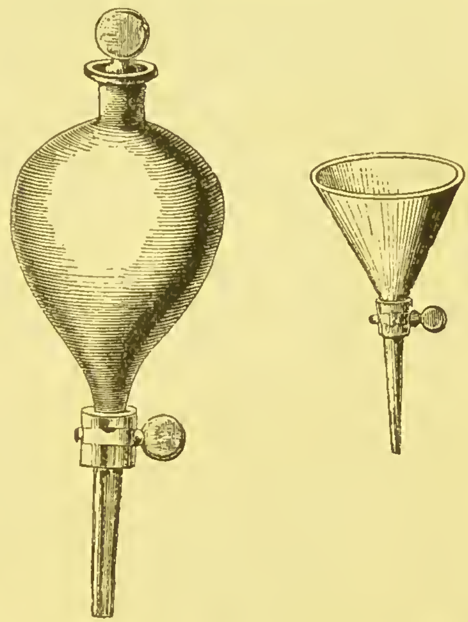


FIG. 29.—A wooden straining-frame with calico tacked thereon, for washing and collecting bulky precipitates (*e.g.*, Fe_26HO) in preparing scale compounds.

Decantation is the operation involved in the separation of the clear supernatant liquid from a precipitate or sediment collected at the bottom of a vessel. To facilitate the operation without spilling or disturbing the sediment, the use of a syphon is probably the most expeditious procedure. A method sometimes

resorted to with cumbrous vessels unprovided with spouts, consists in greasing the rim over which it is intended to pour the liquid (thereby diminishing the play of adhesion, and thus allowing the liquid to be poured evenly without spilling down the outer surface of the vessel). In certain operations the use of glass separators is preferable (see figs. 30, 31, 32, and 33).

Decantation is involved in the preparation among others of *Collodion, Liquor Gutta Percha, Extractum Mezerei Æthereum.* Inexpensive minerals such as calamine, limestone, and others are well powdered, intimately mixed with a large volume of water, set aside for a short time (whereby the coarser and heavier particles subside), and the supernatant turbid liquid decanted off from the coarse sediment into another vessel and there allowed some weeks to settle. This second sediment, necessarily in a fine state of division, is termed the "eleutriated ore," the process—*eleutriation. Calamina Præparata* and *Creta Præparata* are thus prepared.



FIGS. 30 and 31.—Glass separator and funnel.

For an apparatus to hasten the separation of suspended particles in liquids, or to separate emulsive mixtures of immiscible fluids, see *Centrifugal Apparatus* (p. 39).

Lixiviation (Lat. *lix*, *licis*, *m*, ash; lye)—the treatment of ashes (*i.e.*, the residue of anything which has been ignited) with water, with the object of extracting their soluble matters; the resulting solution is "lye." Pearl-ash, for instance, is the product of the lixiviation of wood-ashes, being the residue left on the evaporation of the lye to dryness. Among other products obtained by the process of lixiviation are—Sodium carbonate by the Leblanc process, potassium and sodium iodides and bromides, &c.

The galenical process of percolation (used in extracting crude "vegetable and animal products") is said to have had its origin in the method adopted for effecting the lixiviation of ash (see fig. 34).

Diffusion of Liquids.—If two liquids of different densities

capable of permanent admixture be carefully brought in contact with each other, it will be found that gradual intermixture or

FIG. 32.—A tall jar suitable for decantation.

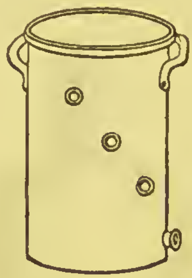


FIG. 33.—A capacious decantation jar fitted with outlets at different levels.

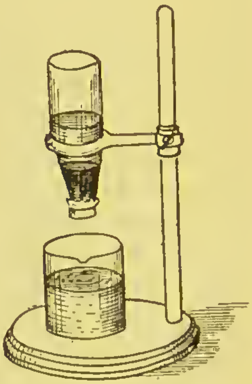


FIG. 34.—Apparatus for the lixiviation of ash—an inverted wine bottle (with the bottom ground off), the neck being tied over with calico to support the ash.

diffusion will take place. This may be readily illustrated by introducing, by means of a thistle-funnel, into a glass vessel containing water, coloured with tincture of litmus, some sulphuric acid, when the blue colour of the litmus will, owing to the upward diffusion of the acid, gradually become changed to red. The results of Graham's elaborate researches on the subject may be briefly summarised as follows:—

That *acids* and *crystalline substances* diffuse into water with comparative rapidity, whereas non-crystalline substances, such as gum, starch, gelatin (termed *colloids*, from κόλλη, glue), diffuse with extreme slowness, and further that colloid substances form a medium which arrests the passage of other colloids, but through which crystalline substances are capable of diffusing. The following table gives the relative times of equal diffusion:—

Hydrochloric acid, .	1·0	Magnesium sulphate, .	7·0
Sodium chloride, . .	2·3	Albumen, . . .	49·0
Sugar, ...	7·0	Caramel, . . .	98·0

The application of heat aids diffusion.

Osmosis.—This term is applied to denote the diffusion or passage of liquids through porous diaphragms. When different liquids of different densities, but capable of admixture, are separated from each other by means of membranous diaphragms

of animal or vegetable parchment, certain phenomena resembling capillarity are produced, resulting in the carriage of both liquids across the membranous septum in unequal quantities, the current flowing in so as to increase the volume being termed *endosmose*, and the lesser current flowing out *exosmose.* From numerous experiments Graham was led to infer that, in order to induce osmotic action between two liquids, they must each be capable of acting chemically, but in different degrees, on the diaphragm separating them. No perfectly satisfactory explanation, however, of these opposing currents of fluid has as yet been given. It should be borne in mind that of the two liquids, the one which *wets* the diaphragm more readily, passes through the faster, and that the septa belong to the class of substances known as colloid. The operations of osmosis and liquid diffusion are considered to be intimately connected with the processes of absorption, nutrition, and secretion in the animal and vegetable economies.

Dialysis is a practical application of the unequal rates of diffusion of liquids submitted to osmotic action by means of diaphragms, whereby crystalline matter may be separated from colloids (see paragraph above). It has already been stated that *crystalloids* diffuse rapidly, and *colloids* slowly; now, if a mixture of such bodies be placed in a cylinder, the bottom end of which

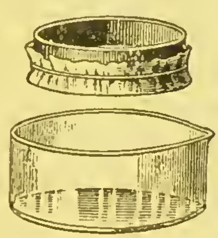


FIG. 35.—Dialyser and Dish.

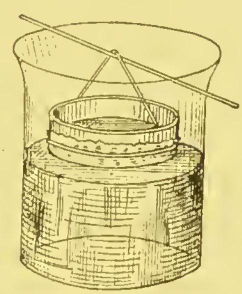


FIG. 36.

has been previously securely tied over with parchment paper[1] (fig. 35), and the whole floated or supported in an open vessel containing distilled water (fig. 36), it will be found that the crystalline matter will rapidly pass through into the water (which should from time to time be renewed), leaving the colloid substances on the septum. Dialysis has received important applications in chemical

[1] This constitutes the Dialyser—the parchment paper should be rigorously examined to ensure absence of holes, and moistened with water previous to tying on.

analysis, pharmacy, and toxicology in the extraction of crystalline matter from organic substances, and in preparing certain colloid metallic hydrates (iron, chromium and aluminium, &c.). The portion passing out through the septum of the dialyser is termed the *diffusate*, whereas the portion left in the dialyser is termed the *dialysate*—*e.g.*, Liq. Ferri *Dialysatus*.

Decoloration.—As the term implies, decoloration denotes the removal of colour from substances. This is effected in various ways, viz., by the use of chemical bleaching-agents, such as sulphurous acid, chlorine, peroxide of hydrogen, or by prolonged exposure to light, as in bleaching fixed oils, wax, and other bodies, or by precipitation with reagents. As an example of so-called "decoloration" effected with chemical reagents, the non-pharmacopœial preparation known as *Tinctura Iodi Decolorata* may be mentioned, the decolorising agents used for destroying the colour of the iodine being either ammonia (British Pharmaceutical Conference Formulary) or sodium hyposulphite.

The processes of decoloration chiefly resorted to in pharmacy, however, are for organic colouring matters (in aqueous solution), methods apparently accompanied with less chemical change than with the above so-called bleaching-agents, namely, by digestion with insoluble heavy metallic oxides or filtering through animal charcoal, or by adding a solution of egg-albumen, and, in the latter instance, heating the liquid to the boiling-point. Their action as decolorising agents is in a measure probably due to the adhesion or surface attraction exerted between them and the colouring matter; the student should bear in mind, however, that such bodies (more especially animal charcoal) exert a similar affinity towards alkaloids and other active principles which might be present in the solution to be operated upon, and that such are apt to be partially if not wholly removed in conjunction with the colouring matter, in the process. The process of dialysis also affords a means of separating colloid colouring matter from solutions of crystalline substances.

Crystals.—A crystal may be defined as a body which possesses naturally a distinct geometrical figure, bounded by plane surfaces, and having angles of constant value. The forms of crystals can only be accurately determined by delicate instruments—*goniometers*, &c.

Substances of a similar chemical constitution, crystallising in the same forms, are termed, *isomorphous*, *e.g.*, zinc sulphate and magnesium sulphate; when the same substance crystallises in two different crystallographic systems it is termed *dimorphous*. Unorganised bodies which exhibit no crystalline structure, such as

glass and glue, are termed *amorphous*, the fracture of such bodies being generally conchoidal.

Modes of procuring Crystals.—Crystalline structure is not confined to minerals, for the majority of chemical substances, when passing from the fluid (molten, liquid, or gaseous) into the solid state, assume some definite geometric form, and are said to *crystallise.* Crystals thus obtained have been termed *artificial.* For example, such may be produced by dissolving substances like common salt, alum, blue vitriol, or nitre, in water,[1] and allowing the solution to spontaneously evaporate, very perfect crystals being the result of the very slow evaporation of the solvent with as little disturbance as possible.

Separation of Salts by Crystallisation.—"The process of crystallisation from solution often affords a means of separating two salts of unequal solubility, the crystalline forms of which are different, and which have no chemical action on each other; nitre is thus purified from the eommon salt which always occurs mixed with it. This proeess is very generally resorted to as a means of purifying salts from small quantities of foreign admixtures, which may be soluble in water, but which either do not crystallise, or if they crystallise, do not do so in dilute solutions. Each crystallisation diminishes the quantity of adhering impurity, and after the process has been repeated three or four times, dissolving each successive crop of crystals in fresh portions of pure water, the product will in most cases be free from impurity. The crystallisation of sea-salt from sea water thus separates the sodium chloride from magnesium chloride, and from various other salts which are present with it in small proportions; a single crystallisation gives the salt sufficiently pure for commercial purposes, though it is in this state far from being chemically free from the bodies which accompany it in the water of the ocean. A single crystallisation of many salts, however, may be made to furnish the salt very nearly chemically pure, if the solution be briskly stirred whilst the crystals are being formed. The salt is thus deposited in minute detached grains; and if these are placed to drain, and washed with a saturated solution of the pure salt, as is practised in the refining of nitre, the *mother-liquor*, which retains the impurities dissolved, may be completely washed away; but if the crystals be allowed to be deposited slowly and to acquire a large volume, the mother-liquor is retained between the layers of each crystal, and cannot

[1] The solution of salts is attended with depression of temperature (the principle of certain forms of "freezing mixtures:" *e.g.*, a mixture of Sal-ammoniae, 5 parts; Nitre, 5; Glauber's Salt, 8; and 16 of water at 10° C. lowers the temperature to $-15^\circ{\cdot}5$ C.).

be thoroughly displaced by the pure solution. Bodies which possess the same crystalline form, such as potassium sulphate and chromate, cannot thus be separated from each other by crystallisation.

"Where the forces of cohesion and adhesion are nearly balanced, as in saturated solutions, very slight causes may occasion the cohesion to preponderate; and when once this force has been set in action, its influence spreads rapidly throughout the mass. Water, for example, in a still atmosphere, may be cooled 8 or 10 degrees below the freezing-point, and yet continue liquid; but the slightest vibration of the vessel causes sudden crystallisation of a portion of the liquid into ice. Sometimes a similar effect is produced, as in the case of Glauber's salt, by the sudden admission of air to the solution of the salt saturated at a high temperature, and from which the air has been expelled by boiling. Adhesion to a solid body may be sufficient to disturb the balance; thus, the dropping in of a similar crystal, the insertion of a thread, or of a wire, or of a piece of stick, if not sufficient to cause sudden crystallisation, will generally determine the spot upon which the crystals are first formed, especially if the foreign body or nucleus be rough and irregular in its outline. For this reason threads are stretched across the vessels in which the pure solution of sugar is set aside to crystallise in the manufacture of sugar-candy; so also wooden rods are placed in solutions of cupric acetate, and copper wires are suspended in solutions of borax in order to facilitate the crystallisation of the salt" (Miller's *Elements of Chemistry*, p. 124).

Water of Crystallisation.—Many chemical substances, in assuming the crystalline form, require as a constituent essential to their structure, definite molecular proportions of water—termed *water of crystallisation.*[1]

Crystalline salts containing water thus combined are found generally to lose their characteristic colours when their crystalline structure is destroyed by the removal of their water of crystallisation, in illustration of which phenomenon the behaviour of sulphate of copper (blue vitriol)[2] $CuSO_4 5H_2O$ is an excellent example.

[1] Alcohol, petroleum spirit, and other solvents unite in the same manner with many substances crystallised from their respective solutions.

[2] The formula for anhydrous sulphate of copper (a buff-coloured powder) is $CuSO_4$; if water be again added, its blue colour is restored. Many of the so-called invisible inks (*e.g.*, solution of chloride of cobalt), which, after having been used for writing and allowed to dry in the usual way, become visible on warming the paper, owe their properties to similar phemomena—(in the present example, blue anhydrous chloride of cobalt being formed).

Formerly, water of crystallisation was regarded as the amount expelled from a crystalline compound by prolonged exposure in a vacuum, or when heated at a temperature of 100° C., until aqueous vapour ceased to be evolved, any water not so expelled being regarded as possessing a more intimate relationship with the chemical nature of the compound, and termed *water of constitution;*[1] compounds from which the latter and all water of crystallisation has been removed, together with such crystals (*e.g.*, potassium nitrate, KNO_3) as contain no water, are termed *anhydrous.*

Crystalline compounds which, upon exposure to the atmosphere at ordinary temperatures, crumble to powder and lose their characteristic form, owing to the vaporisation of their water of crystallisation, are said to be *efflorescent* (*e.g.*, sodium carbonate). Bodies which, on the other hand, become moist and ultimately liquid by the absorption of aqueous vapour from the atmosphere, are said to undergo *deliquescence.*

The Drying of Crystals.—In small operations, crystals recently removed from the mother-liquors are dried either by exposure to the air, or by means of absorbent materials, such as folds of ordinary

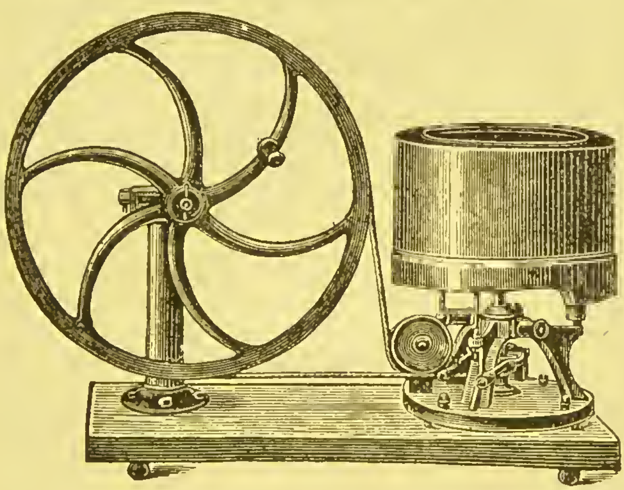


FIG. 37.—Centrifugal apparatus.

filter-paper, or upon porous bricks or tiles; also by exposure over sulphuric acid or calcium chloride in glass vessels termed "desiccators." In larger operations the drying process may be more conveniently and effectively performed by means of a centrifugal machine.

Centrifugal Apparatus.—This machine (fig. 37), a useful acces-

[1] A formula representing this difference between water of crystallisation and of so-called constitution is generally written $CuSO_4.H_2O.4Aq$.

sory for the laboratory, consists of an inner open copper drum, or cage, freely perforated with holes, and so supported that it can be made to revolve at about 1500 or more revolutions per minute, with a perfectly regular and smooth motion; this perforated drum is protected by an outer, strong, cast-iron case. Wet substances, such as crystals, &c., introduced into the drum, and the whole set in rapid revolution, may be thus quickly freed from excessive water—the latter, owing to centrifugal action, being forced through the perforations, and run off by an exit tube at the base; machines of this kind are accordingly sometimes designated "hydro-extractors."

The action of the *centrifugal turn-table*, a useful apparatus for rapidly effecting the separation of mechanical mixtures of liquids

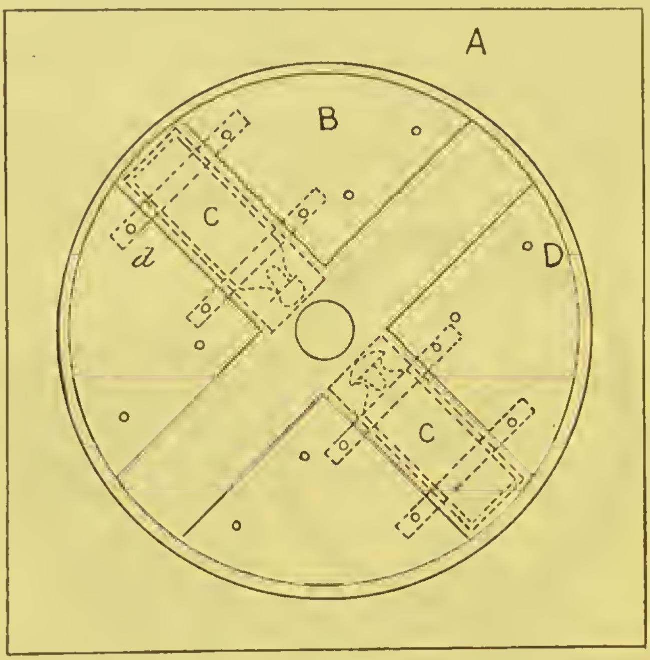


FIG. 38.—Plan of centrifugal table. (See fig. 39.)

of different specific gravity (emulsions, &c.), or of solid particles of a density different from that of the liquid in which they may be suspended,[1] is based upon similar principles.

[1] The centrifugal machine enables us to obtain in a short time considerable quantities of perfectly clear serum, which is thus obtained before any putrefactive change can have affected its composition. When serum has been merely decanted from the clot, it is generally more or less reddish from the presence of suspended corpuscles. From such reddish serum, serum quite free from corpuscles can be obtained by subjecting it to rotation in the centrifugal machine for half an hour (Gamgee's *Physiological Chemistry*, p. 59).

"*Scale*" *Compounds.*—This term is applied to certain pharmacopœial chemical preparations, which, being difficultly crystallisable, are obtained in the solid form in a special manner. Their concentrated aqueous solutions (evaporated to the consistence of syrup) are spread (painted) upon large sheets of glass, which are transferred to a drying closet, and when dry, the thin transparent

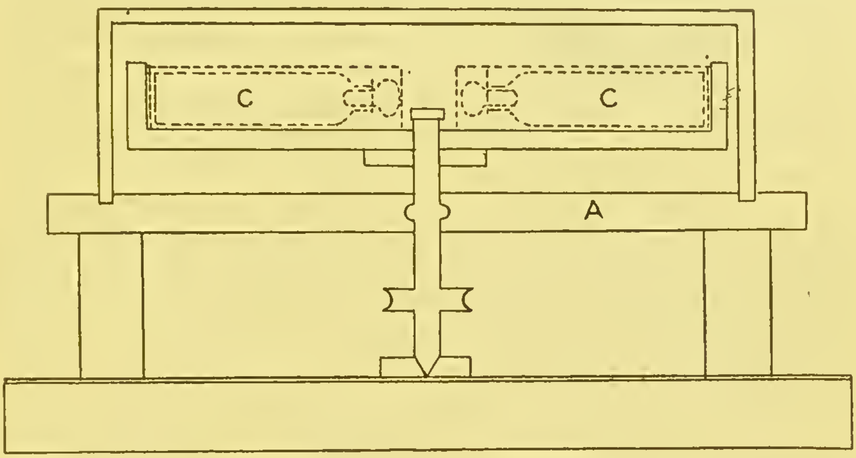


Fig. 39.—Section of centrifugal table (with wooden cover). A, wooden table; B, circular turn-table; C, glass vessels containing liquid to be operated upon, enclosed in strong tinned iron case (the interstice being filled with water); D, holes for straps or clamps (*d*).

film is scraped off, the fragments constituting the "scales," *e.g.*: Ferri et Ammoniæ Citras; Ferri et Quininæ Citras; Ferrum Tartaratum; Bismuthi et Ammoniæ Citras; Beberinæ Sulphas (a mixture of *Nectandra* alkaloids).

Pulverisation.—Small crystals, and solid chemical substances generally, may be readily ground to powder by *trituration* in a porcelain mortar (fig. 40). Upon the large scale the horizontal form of millstones are said to be used for grinding crystals in preference to steel-mills. Many insoluble substances, especially those used in the arts as pigments, are more effectively ground to impalpable powders in the moist condition (added water), the process being termed *levigation*; Hydrargyri Oxidum

Fig. 40.—Porcelain mortar.

Fig. 41.—A small agate mortar for analytical purposes.

Rubrum (*Brit. Pharm.*) may be most perfectly powdered by this treatment.

Camphor and spermaceti are more effectually pulverised by previously moistening with ethylic alcohol (rectified spirit).

When levigation is conducted on a flat slab of *porphyry* (a very hard variegated rock of a purple and white colour), with a kind of stone pestle ground flat at the base (generally of the same material), termed a "muller," the process is termed *porphyrisation* (fig. 42).

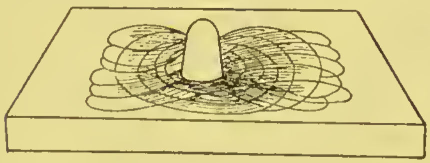


Fig. 42.—Slab and muller for porphyrisation.

Granulation.—A process of division, varying with the nature of the substance operated upon. Metals, such as zinc, may be granulated by melting and pouring the molten mass from a height into water; phosphorus by liquefying under alcohol, and agitating the mixture until cold.

Crystalline salts are granulated by

(1) Briskly stirring their very concentrated aqueous solutions during their evaporation by the application of heat, *e.g.*, *Sodii Hypophosphis*, *Potassii Carbonas* (*Brit. Pharm.*): or

(2) By mixing dry crystalline powders and heating the mixture to 200°–220° F. with brisk agitation: *e.g.*, *Sodii Citrotartras Effervescens*, the so-called *granular* effervescent magnesia.

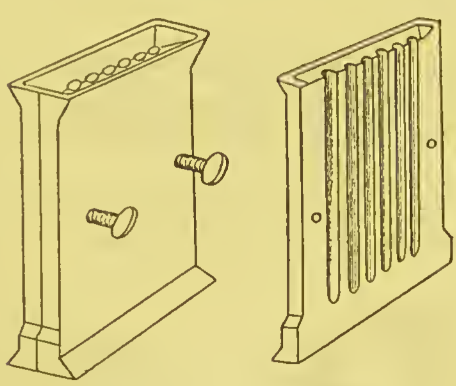


Fig. 43.—Metal mould.

Ferri Sulphas Granulata is prepared by filtering a hot concentrated aqueous solution of ferrous sulphate into a vessel containing rectified spirit.

Fusion.—This term differs from "liquefaction" (*q.v.*) in that it is reserved to designate the operation of melting mineral bodies.

There are several pharmacopœial chemicals which bear evidence of having been solidified from the fused condition, such as roll sulphur and phosphorus; *Potassa Caustica*, *Soda Caustica*, *Argenti Nitras* (caustic), and *Argenti et Potassii Nitras* (mitigated caustic) also occur in sticks, thus obtained by pouring their fused masses into

metal moulds, for the two former (fig. 43) the process of fusion being conducted in silver dishes, for the two latter dishes of platinum.

Potassii Cyanidum and *Potassa Sulphurata* are prepared by fusion and pouring out upon a clean flagstone to cool. *Bismuthum* and *Antimonium Sulphuratum* are likewise directed to be purified by fusion; for these Hessian crucibles are used.

The fusion of *Potassii Acetas*, *Ammonii Nitras*, and *Sulphuris Iodidum* is generally conducted in glass flasks.

The more important Groups of Educts or Proximate Constituents of Plants.

Alkaloids.—The term "alkaloid" is applied to the naturally occurring organic bases of vegetable origin; they all contain nitrogen, and are regarded as ammonia bases, in that they possess alkaline properties, and combine with acids (*e.g.*, HCl) without elimination of H_2O. Most are pyridine derivatives, produced, probably, by the action of ammonia or amido-compounds upon non-nitrogenous matter. (Organic bases produced in the decay of animal substances are termed *ptomaines.*)

Non-volatile alkaloids (subliming with partial decomposition) are compounds of carbon, nitrogen, oxygen, and hydrogen, *e.g.*, quinine.

Volatile or *liquid alkaloids*, *e.g.*, conine, nicotine, sparteine, are composed of carbon, nitrogen, and hydrogen; they possess high boiling-points, and like the non-volatile alkaloids form crystallisable salts with acids.

The free non-volatile bases are colourless crystalline or white amorphous bodies (*berberine* is the only coloured alkaloid [?]), sparingly soluble in water, abundantly as a rule in alcohol, and frequently in one or other of the following solvents immiscible with water, viz., ether, chloroform, amylic alcohol, and petroleum spirit. Their salts (sulphates, nitrates, hydrochlorates, and acetates) are generally soluble in both water and alcohol, but, as a rule, they are insoluble in the above-mentioned immiscible solvents. An important means of extracting the free alkaloids from their aqueous acidified solutions (thus ensuring their presence as salts)[1] consists therefore in dividing such solution into, say, four

[1] The drug to be examined for an alkaloid may in the first instance be *extracted* with very dilute hydrochloric acid. Another method is to mix the powdered drug into paste with calcined magnesia and water, or with milk of lime, evaporate to dryness on a water-bath, and exhaust the dry powder with chloroform or other solvents enumerated above.

portions; (1) agitating the first with ether, the second with chloroform, the third with amylic alcohol, the fourth with petroleum spirit —thereby removing in each case any non-alkaloidal extraneous matter which might be soluble in such immiscible solvent; (2) allowing the liquids to separate, removing and rejecting the possibly impregnated layers of the immiscible solvents; (3) adding a fresh portion of the respective solvent to the remaining aqueous portions (of No. 2), rendering slightly alkaline with solution of soda or ammonia, agitating thoroughly, and setting aside to separate; (4) the free base will generally be found in one or other of the ethereal, chloroformic (&c.) layers, it being left as a residue upon evaporation of the same to dryness on a water-bath.

In the plant they are generally found in combination with organic acids, *e.g.*, morphine with meconic acid, as meconate.

The Pharmacopœial Alkaloids are :—

Aconitina.	*Codeina.*
Apomorphina (derived).	*Conina.*
Atropina.	*Morphina.*
Beberina.	*Physostigmina.*
Caffeina.	*Pilocarpina.*
Cinchonidina.	*Quinina.*
Cinchonina.	*Strychnina.*
Cocaina.	*Veratrina.*

"The detection and exact recognition of the vegetable alkaloids is one of the most important and delicate operations that can fall to the lot of the chemist to attempt" (*Hanbury*).

A reagent serviceable for detecting the presence of an alkaloid in any crude drug is the following mixture (as modified by Lyons) known as Prollius' Fluid, viz. :—

Ether, ...	250 c.c.
Chloroform, ...	80 to 100 „
Ethylic alcohol, ...	25 „
Strong solution of ammonia (sp. gr. ·891), .	10 „

Upon three or four hours' maceration in this mixture of the drug (in fine powder) to be examined, the ammonia therein contained decomposes the alkaloidal salt occurring in the substance, the alkaloid thus liberated being dissolved by the ethereal mixture. The latter is then filtered off, shaken with water acidulated with sulphuric acid, and a portion of the aqueous layer tested for alkaloids with the general reagents (*e.g.*, potassio-mercuric iodide, known as Mayer's reagent, *q.v.*; an aqueous solution of iodine in potassium iodide, &c.).

Standardised Preparations : [1] —

Extractum Nucis Vomicæ,		15	per cent.	Alkaloids.
Tinctura ,, ,, .		1	grain	Alkaloids in 1 fluid ounce.
Opium ,, ,, .		10	per cent.	Morphine.
Extractum Opii,	,, about	20	,,	,,
Tinctura ,,	,, ,,	0·75	,,	,,
Extractum ,, *Liquidum,*	,,	1	,,	,,
Cinchonæ Rubræ Cortex,	,,	5–6	,,	Alkaloids.
Extractum Cinchonæ Liq.,	,,	5	,,	,,

Glucosides.—These bodies are so termed, because, when submitted to the action of acids or certain ferments, they split up into other important substances (alcohols, aldehydes, and phenols) and sugar, and are therefore regarded as ethereal derivations of the glucoses. They are compounds of carbon, hydrogen, and oxygen, frequently possess a bitter taste, and are generally soluble in alcohol and in water. Their extraction from crude drugs requires special treatment for each, *e.g.*, chrysophan (in chrysarobinum), saponin, arbutin, gentisin, *tannin*, *salicin;* the two latter are pharmacopœial.

Neutral principles (generally *bitter*) are indifferent proximate crystalline principles, whose chemical characters have as yet been but indistinctly indicated, *e.g.*, *santonin*, *elaterin*, *aloin*, picrotoxin. Similar remarks apply to many *vegetable colouring matters*, *e.g.*, carthamin from safflower, brasilin the red colouring-matter of Brazil-wood, chlorophyll.

Tannins or Tannic Acids.—These obscurely crystalline solids are very widely distributed in plants, possessing an astringent taste, and a feebly acid reaction. They are freely soluble in alcohol and water, and are powerful reducing agents. They may be divided into two groups :—

(1) Glucosidal tannins, which generally give blue precipitates with ferric salts; and

(2) Non-glucosidal tannins (the more effectual as "tanning agents") giving olive-green precipitates with ferric salts.

Acidum Tannicum is pharmacopœial.

[1] "Before any proposal can be made to introduce into the British Pharmacopœia standard galenical preparations of potent drugs, that is, preparations which contain a constant quantity of the active principle or principles, we require to know—(1) How to accurately estimate the quantity of the active principle in the crude drug from which the preparations are to be made; (2) what solvent ought to be used to extract the active constituents; (3) what part of the plant is best used; (4) what physical condition of the preparation is most compatible with the production of a standard preparation; and (5) how to estimate the quantity of the active constituents in the preparations" (*Dunstan* and *Ransom*).

Acids.—The organic acids contained in plants constitute a very large and important class of substances; they are generally compounds of C, H and O, their basicity, as characteristic of mineral acids, corresponding to the number of hydrogen atoms replaceable by metals.

The Pharmacopœial Vegetable Acids are:—

A. Citricum.	*A. Oleicum.*
A. Gallicum.	*A. Salicylicum.*
A. Lacticum (anim. origin).	*A. Tartaricum.*
A. Meconicum.	*A. Tannicum.*

Fixed Oils, Fats (concrete fixed oils), and Waxes.—Fixed oils, occurring chiefly in fruits and seeds, are fats which at ordinary temperatures remain liquid. They are generally of a yellow colour; some, however, are green (due in most cases to the presence of dissolved chlorophyll), and all are bleached by prolonged exposure to light. When dropped on paper, they leave a permanent stain or grease-spot, and as a rule they are optically inactive to polarised light. Their specific gravity ranges from ·870 to ·970, upon which account they readily float on the surface of water. They are termed "fixed," because they cannot be distilled without decomposition, the temperature at which the latter takes place being erroneously termed their "boiling-point."

Drying Oils.—Certain fixed oils (*e.g.*, linseed, poppy seed) when exposed to the air in thin films, absorb oxygen, and become converted into a hard transparent varnish; these are termed "drying oils," and constitute an important vehicle for pigments ("paints").

Non-drying oils, exposed in a similar manner, remain practically unchanged when pure; but if they contain much extraneous matter or moisture derived from the tissues from which the oil has been extracted, they are liable to develop free fatty acids, and, as popularly termed, "become rancid." Such rancidity may frequently be removed by washing the oil with hot water. Fats and fixed oils are freely miscible with each other, and freely soluble in ether, chloroform, carbon disulphide, and benzene. They are collected by expression of the fresh substances yielding them; the best qualities are obtained by expression in the cold, or at a temperature (for solid fats such as Ol. Theobromatis) not much exceeding their melting-points. They may be also "extracted" by means of the above-mentioned solvents.

Chemically considered, fixed oils, fats, and waxes are ethers of the higher fatty acids. Oils and fats are notably glycerides or glycyl ethers, waxes chiefly ethers of higher alcohols of the ethylic series. The former mostly consist of three or more proximate

principles, among which are olein, palmitin, stearin—glycerides of oleic, palmitic, and stearic acids respectively. Olein is liquid, palmitin and stearin are solids at the ordinary temperature.

The Pharmacopœial Fixed Oils are :—

Of Vegetable Origin—
Concrete :
Ol. Myristicæ Exp.
,, *Theobromatis.*
Liquid :
Ol. Amygdalæ.
,, *Crotonis.*
,, *Lini.*
,, *Olivæ.*
,, *Ricini.*

Of Animal Origin—
Concrete :
Adeps.
Sevum præparatum.
Liquid :
Ol. Morrhuæ.
Waxes :
Cera flava, and C. alba.
Cetaceum.

Saponification.—When fixed oils and fats are heated under pressure with water (about ten atmospheres), chemical reaction takes place, and they become split up into the free fatty acids with liberation of glycerol (glycerine). A similar change takes place when fats and oils are agitated with solutions of the alkalis (*potash*, *soda*, *ammonia*), the fatty acids uniting with the alkali to form a "soap," glycerine being liberated; the decomposition of oils in this manner is termed saponification. Heated with lime, magnesia, and other metallic oxides in the presence of water, insoluble soaps are formed, *e.g.*, *Emplastrum Plumbi* (soluble in ether). *Lin. Ammoniæ*, *Lin. Calcis*, and *Lin. Hydrargyri* are also soaps (of a creamy consistence).

So-called mineral oils and fats, *e.g.*, *Paraffinum Durum* and *P. Molle* are naturally from their chemical composition not saponifiable.

The Oleata or Oleates are salts of oleic acid.[1] Chemically, *Emp. Plumbi* is lead oleate, stearate, and palmitate.

Oleatum Hydrargyri.—1 oz. yellow oxide of mercury and 9 oz. of oleic acid.

Oleatum Zinci.—1 oz. oxide of zinc and 9 oz. oleic acid.

Volatile, Essential, or Ethereal Oils.—The characteristic odours of plants are, as a rule, due to the presence of these proximate principles. They possess but few properties in common with the fixed oils and fats of plants, except as regards their free solubility in the same, and the same solvents, viz., ether, chloroform, petroleum spirit, and carbon disulphide. Unlike fixed oils, however, they are more freely soluble in alcohol, slightly soluble in water, and should leave no permanent greasy stain on paper moistened with them. All are inflammable, and possess a specific

[1] Oleic acid is usually not quite pure (Ph.B.).

gravity ranging from ·845 to ·950; a few are, however, heavier than water, *e.g.*, *Oleum Cinnamomi; Ol. Caryophylli.*

Volatile oils, by exposure to light and air, deepen in colour, become oxidised, less limpid, and in some instances, resinous solids; indeed, they are generally associated with resins in the plants yielding them.

They may be isolated from the crude material by distillation, viz., by passing a current of steam through the substance arranged in an apparatus suitable for the condensation and collection of the product (fig. 44). The oil will be found in a layer at the top (fig. 45) or bottom of the aqueous distillate, the latter constituting an aqueous saturated solution of the oil of the substance treated (cf. *Aquæ*). Essential oils of almond, mustard, horse-radish, and cherry-laurel, do not occur ready formed in the plants

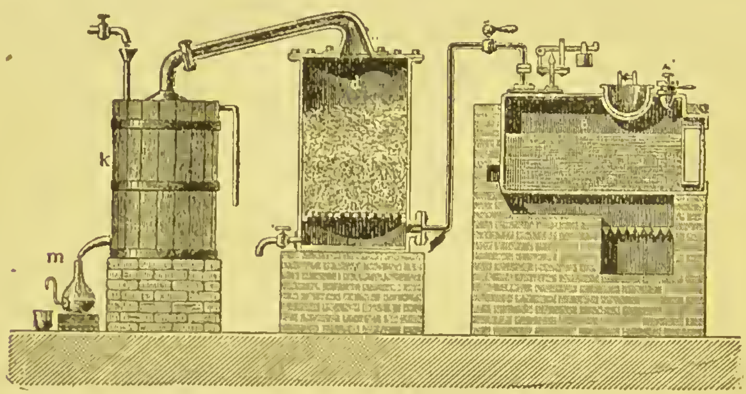


FIG. 44.—Apparatus for distillation. (*a*) perforated diaphragm to support material to be operated upon in cylinder (*d*); (*e*) steam-boiler; (*k*) condensing apparatus; (*m*) the distillate (after *Hager*).

yielding them, but are decomposition products of glucosides. Oil of lemon is directed to be prepared by mechanical means instead of by distillation, the product being more fragrant. Chemically, essential oils may be regarded as hydrocarbons, mostly terpenes, consisting of two or more isomeric modifications of $C_{10}H_{16}$, associated with varying quantities of oxygenated bodies closely allied to the terpenes—termed *camphors* (stearoptenes), possessing higher boiling-points and solidifying on cooling, *e.g.*, *menthol.* These camphors may frequently be isolated by exposing the oil to a very low temperature, when they crystallise out; the liquid hydrocarbon portions left have been termed "elæoptenes."

As an example of the manner in which fragrant essential oils

are isolated from recently gathered fresh plants, the following remarks in reference to the extraction of oil of rosemary have recently appeared in the *Pharmaceutical Journal.*

"For purposes of distillation the young shoots are cut at the end of August or beginning of September, and separated from the wood, *i.e.*, the ends of the main branches as much as possible. The twigs are then packed tightly into a perforated copper vessel, which is covered with a perforated copper lid, and the whole is lifted into the still by a pulley. If the wood be not removed much space is wasted and the oil acquires a terebinthinous rankness. If the rosemary be not distilled soon after being gathered it is liable to heat, and if spread out till the next day it is said to lose much fragrance. Cold water is let into the still until it rises nearly to the level, or within an inch, of the lid, the head of the still is then luted on and clamped, and the mass left to become saturated with water until the next morning.[1] The fire is then lit, and when the water begins to boil the oil distils over. That which comes over during the first twenty-five or thirty minutes is the finest; that which comes over afterwards is small in quantity, inferior in quality, and apt to spoil the rest if allowed to distil into it. A worm of tin pipe in a galvanised iron cylinder is used as a condenser" (*Holmes*).

FIG. 45.—A Florentine separator for collecting the distillate. (*a*) the oil; (*b*) the aqueous distillate (after *Hager*).

The Pharmacopœial Essential Oils are :—

Ol. Anethi.	*Ol. Eucalypti.*
,, *Anisi.*	,, *Juniperi.*
,, *Anthemidis.*	,, *Lavandulæ.*
,, *Cajuputi.*	,, *Limonis.*
,, *Carui.*	,, *Menthæ Piperitæ.*
,, *Caryophylli.*	,, *Menthæ Viridis.*
,, *Cinnamomi.*	,, *Myristicæ.*
,, *Copaibæ.*	,, *Pimentæ.*
,, *Coriandri.*	,, *Pini Sylvestris.*
,, *Cubebæ.*	,, *Rosmarini.*

[1] See nycthemerum process as applied to "Maceration" (*q.v.*).

Ol. Rutæ.	Stearoptenes :
,, *Sabinæ.*	*Camphora.*
,, *Santali.*	*Menthol.*
,, *Sinapis.*	*Thymol.*
,, *Terebinthinæ.*	

Essential oils are not saponifiable.

Enfleurage.—The delicate odours of flowers (which would be deteriorated if distilled) are extracted by immersing the latter for a few days in purified fat. The perfume is then recovered from the impregnated fat by maceration in absolute alcohol, any of the original fixed fat taken up by the alcohol being subsequently removed by application of cold. The process is known as *enfleurage.*

Resins.—It has already been stated under "essential oils" that resins are among the products of their oxidation, and that they frequently occur naturally with them. Natural resins are very complex bodies, being *mixtures* of indifferent substances and of different acids, termed resin acids, closely allied to the terpenes. They are soluble in alkalis (hence the use of alkali in Dec. Aloës Co.; Tr. Guaiaci Ammon. and Tinct. Valer. Ammoniat.) forming resin soaps, their acids being reprecipitated by the addition of mineral acids. Resins are mostly soluble in oil of turpentine, alcohol, and ether. The pharmacopœial resins are :—

Guaiaci Res.	*Pix Burgundica.*
Jalapæ ,,	*Podophylli Res.*
Mastiche.	*Resina.*

Scammoniæ Res.

Oleoresins are naturally-occurring viscid solutions of resins in essential oils, *e.g.:*—

Copaiba.	*Elemi.*
Thus Americanum (a solid).	*Terebinthina Canadensis.*

"*Oleoresina*" *Cubebæ* is extracted from the fruit by means of ether. *Extractum Filicis Liquidum* is an allied product.

Balsams are naturally-occurring oleoresins associated with benzoic or cinnamic acid, or both, *e.g.:*—

B. Peruvianum.	*B. Tolutanum.*
Styrax Præparatus.	*Benzoinum*, a balsamic resin.

Carbohydrates are compounds containing six, or a multiple of six, atoms of carbon, the hydrogen and oxygen found in them being in the same proportion as in water.

They may be arranged in three groups, including :—

(1) $C_6H_{12}O_6$, Grape-Sugar or Dextrose, Fruit-Sugar or Lævulose, and Arabinose.

(2) $C_{12}H_{22}O_{11}$, Cane-Sugar and Melitose.

(3) $(C_6H_{10}O_5)_n$, Dextrin, Gums, Starch, Cellulose.

Starch occurs as granules, which are insoluble in cold water, swell when heated with water above 50° C., and partially dissolve, forming starch paste—the soluble portion being termed *granulose*, the insoluble portion (sacs) *starch cellulose.* Solution is precipitated by alcohol.

Among other starch-like compounds are *Lichinin* from Cetraria islandica and other lichens; and *Inulin* found in Inula Helenium and other roots belonging to the Compositæ.

Gums.—Amorphous transparent bodies widely distributed in plants. They may be divided into three groups, *arabin* or soluble gums, *e.g.*, acacia; *bassorin* or partially soluble gums, *e.g.*, tragacanth; *cerasin* or insoluble gums. Their solutions are precipitated by alcohol.

Cellulose.—The fibrous material and tissues of plants possessing organised structure.

LABORATORY COURSE.

Substances employed in the Chemical Testing of the Pharmacopœial Compounds and Preparations.

Acetate of Sodium.—$NaC_2H_3O_2,3H_2O$. (Also employed in the preparation of acetic ether.)

Benzol.—A colourless volatile liquid, obtained from coal-tar, and consisting chiefly of benzol, C_6H_6. Specific gravity about 0·850.

Benzolated Amylic Alcohol.—Mix together three volumes of benzol and one of amylic alcohol. Decant the supernatant fluid from any deposited water.

Chloride of Barium.—$BaCl_2,2H_2O$.

Copper Foil.—Pure metallic copper, thin and bright.

Ferricyanide of Potassium.—*Synonym:* Red prussiate of potash. $K_6Fe_2C_{12}N_{12}$. *Test.*—Its aqueous solution gives no precipitate with a dilute solution of a pure ferric salt.

Gold, Fine.—Gold, free from metallic impurities.

Hyposulphite of Sodium.—*Synonym:* Thiosulphate of sodium. $Na_2S_2O_3,5H_2O$.

Indigo.—C_8H_5NO. A blue pigment prepared from various species of Indigofera, *Linn.*

Isinglass.—The swimming-bladder or sound of various species of Acipenser, *Linn.*, prepared, and cut into fine shreds.

Litmus.—A blue pigment prepared from various species of Roccella, *DC.*

Litmus-Paper, Blue.—Unsized white paper steeped in solution of litmus, and dried by exposure to the air.

Litmus-Paper, Red.—Unsized white paper steeped in solution of litmus which has been previously reddened by the addition of a very minute quantity of acid, and dried by exposure to the air.

Oxalate of Ammonium.—$(NH_4)_2C_2O_4,H_2O$.

Oxalic acid, ...	1 ounce.
Boiling distilled water, ...	8 fluid ounces.
Carbonate of Ammonium, ...	a sufficiency.

Dissolve the oxalic acid in the water, neutralise the solution with the carbonate of ammonium at, finally, a boiling temperature; filter it while still hot, and set it by that crystals may form as it cools.

Oxalic Acid of Commerce.—Oxalic acid ($H_2C_2O_4,2H_2O$), not quite pure.

Petroleum Spirit.—*Synonym:* Benzoline; petroleum ether. A colourless very volatile and highly inflammable liquid obtained from petroleum, and consisting of a mixture of the lower members of the paraffin or marsh-gas series of hydrocarbons. Boiling-point 122° to 140° F. (50° to 60° C.). Specific gravity about 0·670 to 0·700.

Phenol-Phthalein.—Produced by reaction of phenol and phthalic anhydride. Its tincture yields an intense red colour with potash or soda, hence may be used as an indicator of the termination of volumetric reactions, especially those with organic acids.

Platinum Black.—Platinum in a state of minute division, obtained by adding excess of carbonate of sodium and some sugar to solution of perchloride of platinum, and boiling until a black precipitate is formed, which is washed and dried.

Platinum Foil.

Subacetate of Copper of Commerce.—Verdigris.

Sulphate of Copper, Anhydrous.—$CuSO_4$. Sulphate of copper deprived of its water by a temperature of 400° F. (204°·4 C.) *Characters.*—A yellowish-white powder, which becomes blue when moistened with water.

Sulphide of Iron.—FeS. Prepared by combining its elements in proper proportions by the aid of heat. Small quantities may be produced by applying the end of a rod of iron, heated to whiteness at a blacksmith's forge, to the end of a roll of sulphur, and allowing the sulphide of iron as it is formed to run into a vessel of water.

Sulphuretted Hydrogen.—H_2S.

Sulphide of iron, ...	½ ounce.
Water, ...	4 fluid ounces.
Sulphuric acid, ...	a sufficiency.

Place the sulphide of iron and the water in a gas-bottle closed with a cork perforated by two holes, through one of which passes air-tight a funnel tube of sufficient length to dip into the water, and through the other a tube for giving exit to the gas. Through the former pour from time to time a little of the acid, so as to develop the sulphuretted hydrogen as it may be required. When the gas is employed, either in chemical testing or in the preparation of acidum hydrobromicum dilutum, it should be washed by passing it through a similarly fitted bottle containing water.

Tin, Granulated.—Grain-tin, reduced to small fragments by fusing and, immediately the tin is melted, pouring it in a thin stream into cold water.

Turmeric.—The dried rhizome of Curcuma longa, *Linn.*

Turmeric Paper.—Unsized white paper steeped in tincture of turmeric and dried by exposure to the air.

Turmeric Tincture.

Turmeric, bruised, ...	1 ounce.
Rectified spirit, ...	6 fluid ounces.

Macerate for seven days in a closed vessel, and filter.

Test Reagents (*Solutions*).

Acetate of Copper.

Subacetate of copper of commerce, in fine powder,	½ ounce.
Acetic acid, ...	1 fluid ounce.
Distilled water, ...	a sufficiency.

Dilute the acid with half a fluid ounce of the water ; digest the subacetate of copper in the mixture at a temperature not exceeding 212° F. (100° C.) with repeated stirring, and continue the heat until a dry residue is obtained. Digest this in 4 ounces of boiling distilled water, and by the addition of more of the water make up the solution to 5 fluid ounces. Filter it.

Acetate of Potassium.

Acetate of potassium, ...	½ ounce.
Distilled water, ...	5 fluid ounces.

Acetate of Sodium.

Acetate of sodium, ...	½ ounce.
Distilled water, ...	5 fluid ounces.

Dissolve and filter.

Albumen.

The white of one egg.	
Distilled water, ...	4 fluid ounces.

Mix by trituration in a mortar, and strain through clean tow first moistened with distilled water.

This solution must be recently prepared.

Ammonio-Nitrate of Silver.

Nitrate of silver, in crystals, .	¼ ounce.
Solution of ammonia, . .	½ fluid ounce, or a sufficiency.
Distilled water, ...	a sufficiency.

Dissolve the nitrate of silver in 8 fluid ounces of the water, and to the solution cautiously add the ammonia until the precipitate first formed is nearly dissolved. Clear the solution by filtration, and then add distilled water, so that the bulk may be 10 fluid ounces.

Ammonio-Sulphate of Copper.

Sulphate of copper, in crystals, ...	½ ounce.
Solution of ammonia, ...	a sufficiency.
Distilled water, ...	a sufficiency.

Dissolve the sulphate of copper in 8 fluid ounces of the water, and to the solution cautiously add the ammonia until the precipitate first formed is nearly dissolved. Clear the solution by filtration, and then add distilled water, so that the bulk may be 10 fluid ounces.

Ammonio-Sulphate of Magnesium.

Sulphate of magnesium, ...	1 ounce.
Chloride of ammonium, ...	½ ounce.
Solution of ammonia, ...	½ fluid ounce.
Distilled water, ...	a sufficiency.

Dissolve the sulphate of magnesium and chloride of ammonium in 8 fluid ounces of the water, and to the solution add the ammonia, and as much distilled water as will make up the bulk to 10 fluid ounces. Filter it.

Boric Acid.

Boric acid, ...	50 grains.
Rectified spirit, ...	1 fluid ounce.

Dissolve and filter.

Bromine.

Bromine, ...	10 minims.
Distilled water, ...	5 fluid ounces.

Place the bromine in a bottle furnished with a well-fitting stopper, pour on the water, and shake several times. Keep it excluded from the light.

Carbonate of Ammonium.

Carbonate of ammonium, in small pieces, .	½ ounce.
Solution of ammonia, ...	¾ fluid ounce.
Distilled water, ...	10 fluid ounces.

Dissolve and filter.

Chloride of Ammonium.

Chloride of ammonium, ...	1 ounce.
Distilled water, ...	10 fluid ounces.

Dissolve and filter.

Chloride of Barium.

Chloride of barium, in crystals, . . .	1 ounce.
Distilled water, ...	10 fluid ounces.

Dissolve and filter.

Ferricyanide of Potassium.

Ferricyanide of potassium, in crystals, .	¼ ounce.
Distilled water, ...	5 fluid ounces.

Dissolve and filter.

Ferrocyanide of Potassium.

Ferrocyanide of potassium, in crystals, .	¼ ounce.
Distilled water, ...	5 fluid ounces.

Dissolve and filter.

Iodide of Potassium.

Iodide of potassium, ...	1 ounce.
Distilled water, ...	10 fluid ounces.

Dissolve and filter.

Isinglass.

Isinglass, in shreds, ...	50 grains.
Warm distilled water, ...	5 fluid ounces.

Mix, and digest for half an hour on a water-bath with repeated shaking, and filter through clean tow moistened with distilled water.

Litmus.

Litmus in powder, ...	1 ounce.
Rectified spirit, ...	10 fluid ounces.
Distilled water, ...	10 fluid ounces.

Boil the litmus with 4 fluid ounces of the spirit for one hour, and pour away the clear fluid; repeat this operation with 3 ounces of the spirit; and a third time with the remainder of the spirit. Digest the residual litmus in distilled water, and filter.

Oxalate of Ammonium.

Oxalate of ammonium, ...	½ ounce.
Warm distilled water, ...	1 pint.

Dissolve and filter.

Perchloride of Gold.

Fine gold, reduced by a rolling machine to a thin lamina, ...	60 grains.
Nitric acid, ...	1½ fluid drachms.
Hydrochloric acid, ...	7 fluid drachms.
Distilled water, ...	a sufficiency.

Place the gold in a flask with the nitric acid and 6 fluid drachms of the hydrochloric acid, first mixed with 4 fluid drachms of the water, and digest until it is dissolved. Add to the solution the additional fluid drachm of hydrochloric acid, evaporate at a temperature not exceeding 212° F. (100° C.) until acid vapours cease to be given off, and dissolve the chloride of gold thus obtained in 5 fluid ounces of distilled water. The solution should be kept in a stoppered bottle.

Perchloride of Platinum.

Thin platinum foil, ...	¼ ounce.
Nitric acid, ...	a sufficiency.
Hydrochloric acid, ...	a sufficiency.
Distilled water, ...	7 fluid ounces.

Mix a fluid ounce of the nitric acid with 4 fluid ounces of the hydrochloric acid and 2 fluid ounces of the water; pour the mixture into a small flask containing the platinum, and digest with a little heat, adding more of the acids mixed in the same proportion, should this be necessary, until the metal is dissolved. Transfer the solution to a porcelain dish, add to it a fluid drachm of hydrochloric acid, and evaporate on a water-bath, until acid vapours cease to be given off. Let the residue be dissolved in the remaining 5 ounces of distilled water. Filter, and preserve it in a stoppered bottle.

Phosphate of Sodium.

Phosphate of sodium, in crystals, . . .	1 ounce.
Distilled water, ...	10 fluid ounces.

Dissolve and filter.

Potassio-Mercuric Iodide.—*Synonym:* Nessler's reagent.

Iodide of potassium,	135 grains.
Perchloride of mercury,	a sufficiency.
Caustic soda,	2 ounces.
Distilled water,	1 pint.

Dissolve the iodide of potassium and 100 grains of the perchloride of mercury in 15 fluid ounces of boiling distilled water. To this fluid add more aqueous solution of the perchloride of mercury until the precipitate produced no longer continues to disappear on well stirring, and a slight permanent precipitate remains. Then add the caustic soda. When the latter has dissolved, add a little more of the aqueous solution of perchloride of mercury, shake, allow to settle, and dilute the whole with distilled water to the volume of one pint. The solution should be kept in a stoppered bottle.

Stannous Chloride.

Granulated tin,	1 ounce.
Hydrochloric acid,	3 fluid ounces.
Distilled water,	a sufficiency.

Dilute the acid in a flask with 1 fluid ounce of the water, and, having added the tin, apply heat gently until gas ceases to be evolved. Add as much of the water as will make up the bulk to 5 fluid ounces, and transfer the solution, together with the undissolved tin, to a bottle with an accurately ground stopper.

Sulphate of Calcium.

Sulphate of calcium,	¼ ounce.
Distilled water,	1 pint.

Rub the sulphate of calcium in a porcelain mortar for a few minutes with 2 ounces of the water, introduce the mixture thus obtained into a pint bottle containing the rest of the water, shake well several times, and allow the undissolved sulphate to subside. Filter.

Sulphate of Indigo.

Indigo, dry and in fine powder,	5 grains.
Sulphuric acid,	10 fluid ounces.

Mix the indigo with a fluid drachm of the sulphuric acid in a small test-tube, and heat on a water-bath for an hour. Pour the blue liquid into the remainder of the acid, agitate the mixture, and when the undissolved indigo has subsided, decant the clear liquid into a stoppered bottle.

Sulphate of Iron.

Granulated sulphate of iron,	10 grains.
Boiling distilled water,	1 fluid ounce.

Dissolve and filter. This solution should be recently prepared.

Sulphydrate of Ammonium.

Solution of ammonia,	5 fluid ounces.

Put 3 fluid ounces of the ammonia into a bottle, and conduct into this a stream of sulphuretted hydrogen as long as the gas continues to be absorbed; then add the remainder of the ammonia, and transfer the solution to a green glass bottle furnished with a well-ground stopper.

Tartaric Acid.

Tartaric acid, in crystals, ...	1 ounce.
Distilled water, ...	8 fluid ounces.
Rectified spirit, ...	2 fluid ounces.

Dissolve the tartaric acid in the water, add the rectified spirit, and preserve the solution in a stoppered bottle.

Yellow Chromate of Potassium.

Red chromate of potassium, . . .	295 grains.
Bicarbonate of potassium, . . .	200 grains.
Distilled water, ...	10 fluid ounces.

Dissolve the red chromate in the water, and exactly neutralise the solution with the bicarbonate, evolution of all carbonic acid being ensured by ebullition. Filter.

Phenol-Phthalein.

Phenol-phthalein, ...	1 grain.
Proof spirit, ...	500 grains.

Dissolve. The solution should be colourless.

Type I. The Solution of Metals in Acids: the Collection of the Product either in the Liquid or Solid State.

Prepare a sample of Ferri Sulphas.—$FeSO_4.7H_2O$.

Take of Iron wire, . . .	1 ounce.
,, Sulphuric acid, . .	1 fluid ounce.
,, Distilled water, . .	$7\frac{1}{2}$ fluid ounces.

Pour the water on the iron placed in a porcelain dish, add the acid, and when the disengagement of gas has nearly ceased, boil for ten minutes. Filter now through paper, and, after the lapse of twenty-four hours, separate the crystals which have been deposited from the solution. Let these be dried on filtering paper placed on porous bricks, and preserved in a stoppered bottle.

$$Fe_2 + 2H_2SO_4 + xH_2O = 2FeSO_4 + 2H_2 + xH_2O.$$

Characters and Tests.[1]—In oblique rhombic prisms, of a pale greenish-blue colour and styptic taste; insoluble in rectified spirit, soluble in water. The aqueous solution is clear, gives a white precipitate with chloride of barium, a blue with ferricyanide of potassium, and a nearly white or light-blue one with ferrocyanide of potassium. It gives no precipitate with sulphuretted hydrogen.

[1] The student is supposed to perform these tests on his own products, and compare his results with those obtained upon other samples supplied by the demonstrator.

The following pharmacopœial compounds are prepared upon allied principles (*see Preface*) :—

Zinci Sulphas.
,, *Chloridum.*
Liquor Zinci Chloridi.
Liquor Ferri Perchloridi Fortior.
,, ,, *Pernitratis.*
,, ,, *Persulphatis.*
Liquor Hydrargyri Nitratis Acidus.
Hydrargyri Persulphas.
Cupri Nitras.
Argenti Nitras.
Liq. Antimonii Chlor. (from sulphide).

Expose 60 grains of the crystals of sulphate of iron in a porcelain or iron dish to a temperature of 212° F. (100° C.), until aqueous vapour ceases to be given off. Reduce the residue to a fine powder; it is *Ferri Sulphas Exsiccata*, $FeSO_4,H_2O$.

Type II. The Neutralisation of Bases and Acids: Collection of the Product either in Liquid or Solid State.

Prepare a sample of Plumbi Acetas.—$Pb(C_2H_3O_2)_2,3H_2O$.

Take of Oxide of lead, in fine powder, $\frac{1}{2}$ ounce.
,, Acetic acid, ... $\frac{5}{6}$ ounce, or a sufficiency.
,, Distilled water, . . . $\frac{5}{12}$ ounce.

Mix the acetic acid and the water, add the oxide of lead, and dissolve with the aid of a little heat. Filter, evaporate till a pellicle forms, and set aside to crystallise, first adding a little acetic acid should the fluid not have a distinctly acid reaction. Drain and dry the crystals on filtering-paper, without heat.

$$PbO + 2HC_2H_3O_2 = Pb2C_2H_3O_2 + H_2O.$$

Characters and Tests.—In white crystalline masses, slightly efflorescent, having an acetous odour, and a sweet astringent taste. Its solution in water slightly reddens litmus, gives a yellow precipitate with iodide of potassium, and is precipitated white by sulphuric acid, acetic acid being set free. Its solution in distilled water is clear, or has only a slight milkiness, which disappears on the addition of acetic acid.

The following are prepared upon allied principles :—

(With oxides.)
Cupri Sulphas.
Plumbi Nitras.
Antimonium Tartaratum (and an acid salt).

(With hydrates.)
Liq. Ferri Acetatis Fortior.
Sodii Valerianas.
Sodii Salicylas.
Ammonii Benzoas.
,, *Phosphas.*
,, *Bromidum.*

Liq. Plumbi "Subacetatis" is prepared by boiling crystals of lead acetate with lead oxide and water. $PbO + Pb2C_2H_3O_2 = Pb_2O2C_2H_3O_2$.

Type III. By the Saturation of Carbonates with Acids: Collection of Product in Liquid or Solid State.

Prepare a sample of Zinci Acetas.

Take of Carbonate of zinc,	. .	$\frac{1}{2}$ ounce.
,, Acetic acid,	. . .	$1\frac{1}{4}$ ounces.
,, Distilled water,	. . .	$1\frac{1}{2}$ ounces.

Add the carbonate of zinc in successive portions to half the quantity of the acetic acid previously mixed with the water in a flask; heat gently, add by degrees the remainder of the acid till the carbonate is dissolved; boil for a few minutes, filter while hot, and set it aside for two days to crystallise. Decant the mother-liquor; evaporate to one half, and again set it aside for two days to crystallise. Place the crystals in a funnel to drain, then separate them on filtering-paper on a porous tile, and dry them by exposure to the air at ordinary temperatures.

Characters and Tests.—Thin translucent and colourless crystalline plates, of a pearly lustre, with a sharp unpleasant taste; evolving acetic acid when decomposed by sulphuric acid; soluble in water, and the solution precipitated pure white by sulphuretted hydrogen. A dilute watery solution is not affected by chloride of barium (abs. of sulphates) or nitrate of silver (chlorides), and, when slightly acidulated with hydrochloric acid, is not precipitated by sulphuretted hydrogen (lead); after it has been boiled for a few minutes with a little nitric acid, it yields with ammonia a white precipitate (abs. iron) entirely soluble without colour in an excess of the reagent (abs. copper).

The following are prepared upon allied principles:—

Potassii Acetas.
,, *Citras.*
Liq. Ammonii Acetatis Fortior.
,, *Citratis Fortior.*
Ammonii Nitras.

Calcii Chloridum.
Magnesii Sulphas.
Potassii Tartras, } (with acid salts).
Soda Tartarata, }
Lithii Citras.

Type IV. Preparations in which the Process of Fusion is Involved.

(*a*) Initial Fusion.

Prepare a sample of Sodii Arsenias.—$Na_2HAsO_4,7H_2O$.

Take of Arsenious acid,	. . .	$1\frac{1}{2}$ ounces.
,, Nitrate of sodium,	. . .	$\frac{17}{40}$ ounce.
,, Dried carbonate of sodium,	.	$\frac{11}{40}$ ounce.
,, Boiling distilled water,	. .	$1\frac{3}{4}$ ounces.

Reduce the dry ingredients separately to fine powder, and mix

them thoroughly in a mortar. Put the mixture into a eovered Hessian crueible, and expose it to a full red heat, till all effervesceenee has eeased and complete fusion has taken plaee. Pour out the fused salt on a clean slab, and as soon as it has solidified, and while it is still warm, put it into the boiling water, stirring diligently. When the salt has dissolved, filter the solution through paper and set it aside to erystallise. Drain the erystals, dry them rapidly by exposure on filtering-paper, and enelose them in stoppered bottles.

(1) $As_2O_3 + 2NaNO_3 + Na_2CO_3 = Na_4As_2O_7$ (Pyro-Arseniate of Sodium) $+ N_2O_3 + CO_2$.

(2) $Na_4As_2O_7 + 15H_2O = 2\,(Na_2HAsO_4,7H_2O)$.

Characters and Tests.—In eolourless transparent prisms soluble in water, the solution is alkaline, giving white preeipitates with chloride of barium, chloride of ealcium, and sulphate of zinc, and a brick-red preeipitate with nitrate of silver, all of which are soluble in nitrie acid. When freshly erystallised, arseniate of sodium has the eomposition expressed by the formula $Na_2HAsO_4,12H_2O$; this salt loses 53·73 per eent. of its weight when dried at 300° F. (148°·9 C.), beeoming anhydrous. On exposure of the ordinary salt, moisture eseapes, the effloresced salt having the formula $Na_2HAsO_4,7H_2O$. The latter salt loses 40·38 per eent. of its weight when dried at 300° F. (148°·9 C.), beeoming anhydrous. An aqueous solution of 12·4 grains of anhydrous arseniate of sodium, aeidulated with acetic aeid, requires not less than 34 grains of acetate of lead for complete precipitation.

Potassa Sulphurata. | *Potassii Ferrocyanidum.*
Potassii Permanganas. | *Potassii Cyanidum.*
Argenti et Potassii Nitras.

(*b*) By Subsequent Fusion.[1]

Prepare a sample of Potassii Iodidum.—KI.

Take of	Solution of potash (Ph.B.), . .	2 fluid ounces.
,,	Iodine, ...	$\frac{1}{4}$ ounce.
,,	Wood ehareoal, in fine powder, .	16 grains.
,,	Boiling distilled water about . .	2 fluid ounees.

Put the solution of potash into a glass or poreelain vessel, and add iodine in small quantities at a time with eonstant agitation, until the solution aequires a permanent brown tint. Evaporate

[1] Refer to *Brit. Pharm.* and see how *Ammonii Nitras* and *Potassii Acetas* are prepared (*cf.* Fusion).

the whole to dryness in a porcelain dish, pulverise the residue, and mix this intimately with the charcoal. Throw the mixture in small quantities at a time into a red-hot iron crucible, and, when the whole has been brought into a state of fusion, remove the crucible from the fire and pour out its contents. When the fused mass has cooled, dissolve it in the boiling distilled water, filter through paper, wash the filter with a little boiling distilled water, unite the liquids, and evaporate the whole until a film forms on the surface. Set it aside to cool and crystallise. Drain the crystals, and dry them quickly in a warm place. More crystals may be obtained by evaporating the mother-liquor and cooling. The salt should be kept in a stoppered bottle.

$$(1)\ 6KHO + 3I_2 = 5KI + KIO_3 + 3H_2O.$$
$$(2)\ 2KIO_3 + 3C_2 = 2KI + 6CO.^*$$

Characters and Tests.—In colourless, generally opaque, cubic crystals, readily soluble in water, and in a less degree in spirit. It commonly has a feeble alkaline reaction; its solution mixed with mucilage of starch gives a blue colour on the addition of a minute quantity of solution of chlorine (I). It gives a crystalline precipitate ($KHC_4H_4O_6$) with tartaric acid. The addition of tartaric acid (liberating HI from iodide, and HIO_3 from iodate if present) and mucilage of starch to its watery solution does not develop a blue colour $5HI + HIO_3 = 3H_2O + 3I_2$ (abs. of iodate). Solution of nitrate of silver added in excess forms a yellowish-white precipitate which, when agitated with ammonia, yields by subsidence a clear liquid in which excess of nitric acid causes very little turbidity (chlorides). Its aqueous solution is only faintly precipitated by the addition of saccharated solution of lime (carbonates).

The following compounds are prepared upon allied principles:—

Potassii Bromidum.
Sodii Iodidum.
Sodii Bromidum.[1]
Sulphuris Iodidum.

Type V. Products obtained by Calcination of Carbonates.

Prepare a sample of Zinci Oxidum, ZnO.

Take of carbonate of zinc, ¼ ounce. Place the carbonate in a loosely covered Hessian crucible, and expose it to a dull red heat, until a portion taken from the centre of the contents of the crucible, and cooled, no longer effervesces when moistened with water

* Also observe the use of charcoal as a reducing agent in the preparation of *Calx Sulphurata* and *Acidum Sulphurosum* (Ph.B.).

[1] *Ammonii Bromidum* cannot be thus prepared on account of its volatility.

and dropped into diluted sulphuric acid. Let the crucible cool, and transfer the product to a stoppered bottle.

Characters and Tests.—A soft, nearly white, tasteless and inodorous powder, becoming pale yellow when heated. Dissolves without effervescence in diluted nitric acid, forming a solution which is not affected by chloride of barium, nitrate of silver, or diluted sulphuric acid, and giving with carbonate of ammonium a white precipitate which dissolves entirely without colour in an excess of the reagent, forming a solution which is precipitated white by sulphydrate of ammonium.

Oxide of zinc may also be obtained from metallic zinc by combustion. Thus prepared it is white.

The following are prepared upon allied principles :—

Calx.
Magnesia Levis.
Magnesia Ponderosa.

Type VI. By Double Decomposition between Two Soluble Salts in Solution.

Prepare a sample of Ferri Phosphas, $Fe_3 2PO_4, 8H_2O$.

Take of	Sulphate of iron,	1 ounce.
,,	Phosphate of sodium,	$\frac{11}{12}$ ounce.
,,	Bicarbonate of sodium,	$\frac{1}{4}$ ounce.
,,	Boiling distilled water,	a sufficiency.

Dissolve the sulphate of iron in 10 ounces of water, and the phosphate of sodium in a similar quantity of water. When each solution has cooled to between 100° and 130° F. (37°·8 and 54°·4 C.), add the latter to the former, pouring in also a solution of the bicarbonate of sodium in a little distilled water. Mix thoroughly. Transfer the precipitate to a calico filter, and wash it with hot distilled water till the filtrate ceases to give a precipitate with chloride of barium. Finally dry the precipitate at a temperature not exceeding 120° F. (48°·9 C.).

$$3FeSO_4 + 2Na_2HPO_4 + 2NaHCO_3 = Fe_3 2PO_4 + 3Na_2SO_4 + 2H_2O + 2CO_2.$$

Characters and Tests.—A slate-blue amorphous powder, insoluble in water, soluble in hydrochloric acid. The solution yields a precipitate with both the ferrocyanide and ferricyanide of potassium, that afforded by the latter being the more abundant; and when treated with tartaric acid and an excess of ammonia, and subsequently with the solution of ammonio-sulphate of magnesium, lets

fall a crystalline precipitate. When the salt is digested in hydrochloric acid with a lamina of pure copper, a dark deposit does not form on the metal (abs. of arsenium).

Collection of the precipitate.	*Ferri Arsenias.*	*Hydrarg. Iodid. Rubr.*
	Calcii Carbonas Præcipitata.	*Ferri Carbonas Saccharata.*
	Magnesii Carbonas Levis.	*Plumbi Iodidum.*
	,, ,, *Ponderosa.*	*Hydrargyri Oxidum Flavum.*[1]
	Zinci Carbonas.	*Hydrargyrum Ammoniatum.*
	Zinci Valerianas.	*Bismuthi Subnitras.*
	Argenti Oxidum.	,, *Carbonas.*
	Acidum Boricum.	,, *Citras.*
	,, *Chromicum.*	*Antimonii Oxidum.*
	Ferri Perox. Hydratum.	
	Liquor Potassæ.	(Negligence of precipitate, collection of filtrate.)
	Potassa Caustica.	
	Liquor Sodæ.	
	Soda Caustica.	
	Sodii Sulphocarbolas.	
	Sodii Hypophosphis.	
	Acid. Citricum.	
	,, *Tartaricum.*	
	,, *Hydrobrom. Dil.*	

Type VII. Products obtained by Sublimation.

Prepare a sample of Hydrargyri Perchloridum.

Take of	Persulphate of mercury, . . .	$\frac{1}{2}$ ounce.
,,	Chloride of sodium, dried, . .	$\frac{2}{5}$ ounce.
,,	Black oxide of manganese in powder, .	11 grains.

Reduce the persulphate of mercury and the chloride of sodium each to fine powder, and having mixed them and the oxide of manganese thoroughly by trituration in a mortar, put the mixture into an apparatus adapted for sublimation,[2] and apply sufficient heat to cause vapours of perchloride of mercury to rise into the less heated part of the apparatus which has been arranged for their condensation.

$$HgSO_4 + 2NaCl = HgCl_2 + Na_2SO_4.$$

Characters and Tests.—In heavy colourless masses of prismatic crystals, possessing a highly acrid metallic taste; more soluble in alcohol, and still more so in ether, than in water. Its aqueous

[1] See also preparation of *Lotio Hydrargyri Flava* and *Lotio Hydrargyri Nigra* (Ph.B.).

[2] An ordinary porcelain 2 oz. "covered pot" answers very well, the lid being luted down, heated on a sand-bath (with the Bunsen flame) for three-quarters of an hour, and the whole allowed to remain undisturbed till the next day.

solution gives a yellow precipitate with caustic potash, a white precipitate with ammonia, and a curdy white precipitate with nitrate of silver. When heated it sublimes without decomposing, or leaving any residue.

The following are likewise prepared by sublimation :—

Hydrargyri Subchloridum.
Ammonii Carbonas.
Iodum.

Type VIII. Scale Compounds (*q.v.*).

Prepare a sample of Ferri et Quininæ Citras.

Take of	Solution of persulphate of iron,	.	$\frac{3}{4}$ fluid ounce.
,,	Sulphate of quinine,	. .	73 grains.
,,	Diluted sulphuric acid,	. .	2 fluid drachms.
,,	Citric acid,	. . .	$\frac{1}{2}$ ounce and 5 grains.
,,	Solution of ammonia, } of each,	.	a sufficiency.
,,	Distilled water, }		

Mix $1\frac{1}{3}$ fluid ounces of the solution of ammonia with 7 ounces of distilled water, and to this add the solution of persulphate of iron previously diluted with 7 ounces of distilled water, stirring them constantly and briskly. Let the mixture stand for two hours, stirring it occasionally, then put it on a calico filter, and when the liquid has drained away, wash the precipitated ferric hydrate with distilled water until that which passes through the filter ceases to give a precipitate with chloride of barium.

Mix the sulphate of quinine with $1\frac{1}{4}$ ounces of distilled water, add the diluted sulphuric acid, and when the salt is dissolved precipitate the quinine with a slight excess of solution of ammonia. Collect the precipitate on a filter, and wash it with 5 ounces of distilled water.

Dissolve the citric acid in $\frac{5}{6}$ ounce of distilled water, and, having applied the heat of a water-bath, add the ferric hydrate, previously well drained; stir them together, and, when the hydrate has dissolved, add the precipitated quinine, continuing the agitation until this also has dissolved. Let the solution cool, then add in small quantities at a time 2 fluid drachms of solution of ammonia diluted with $2\frac{1}{2}$ drachms of distilled water, stirring the solution briskly, and allowing the quinine which separates with each addition of ammonia to dissolve before the next addition is made. Filter the solution, evaporate it to the consistence of a thin syrup,

then dry it in thin layers on flat porcelain or glass plates at a temperature of 100° F. (37°·8 C.). Remove the dry salt in flakes, and keep it in a stoppered bottle.

Characters and Tests.—Thin scales of greenish golden yellow colour, somewhat deliquescent and entirely soluble in cold water. The solution is very slightly acid, and is precipitated reddish-brown by solution of soda, white by solution of ammonia, blue by the ferrocyanide and ferricyanide of potassium, and greyish-black by tannic acid. The salt has a bitter taste resembling that of quinine, and also possesses a chalybeate flavour. When burned with exposure to air, it leaves a residue which, when moistened with water, is not alkaline to test-paper. Fifty grains dissolved in a fluid ounce of water, and treated with a slight excess of ammonia, gives a white precipitate, which, when dissolved out by successive treatments of the fluid with ether[1] or chloroform, and the latter evaporated, and the residue dried until it ceases to lose weight, weighs $7\frac{1}{2}$ grains. The precipitate is almost entirely soluble in a little pure ether, and when burned leaves but a minute residue.

Type IX. By Distillation (*q.v.*).

Prepare a sample of Æther $(C_2H_5)_2O$.

Take of	Rectified spirit,	5	fluid ounces.
,,	Sulphuric acid,	1	fluid ounce.
,,	Chloride of calcium,	1	ounce.
,,	Slaked lime,	$\frac{1}{20}$	ounce.
,,	Distilled water,	$1\frac{3}{10}$	fluid ounces.

Mix the sulphuric acid with one-fourth of the spirit in a glass flask having a wide neck and capable of containing at least 6 ounces, and, not allowing the mixture to cool, connect the flask by means of a bent glass tube with a Liebig's condenser, and distil at a temperature sufficient to maintain the liquid in brisk ebullition. As soon as the ethereal fluid begins to pass over, supply fresh spirit through a tube into a flask in a continuous stream, and in such quantity as to equal the volume of the fluid which distils

[1] In testing a doubtful sample, the white precipitate soluble in ether is not necessarily quinine, it might be *quinidine;* therefore, remove the ethereal layer to a test-tube, add water and two or three drops of acetic acid, agitate, and boil off the ether (the latter may be ignited at the mouth of the tube during the operation). Divide remaining solution into three portions. To the first add some chlorine or bromine water, then some ammonia, a green coloration = quinine or quinidine, or both; if there were no coloration the bitter alkaloid might probably be berberine. To the second add solution of potassium iodide, a white precipitate = *quinidine;* to the other add solution of ammonium oxalate, a white precipitate = *quinine.*

over. For this purpose use a tube furnished with a stopcock to regulate the supply, connecting one end of the tube with a vessel containing the spirit raised above the level of the flask, and passing the other end into the acid fluid through a cork fitted into the flask. When the whole of the spirit has been added, and 4 fluid ounces have distilled over, the process may be stopped.

$$(1)\ C_2H_5HO + H_2SO_4 = C_2H_5HSO_4 + H_2O.$$
$$(2)\ C_2H_5HO + C_2H_5HSO_4 = (C_2H_5)_2O + H_2SO_4.$$

Purification.—Dissolve the chloride of calcium in the water, add the lime, and agitate the mixture in a bottle with the impure ether. Leave the mixture at rest for ten minutes, pour off the light supernatant fluid, and redistil it until a glass bead of specific gravity 0·735 placed in the receiver begins to float.

Characters and Tests.—A colourless, very volatile and inflammable liquid, emitting a strong and characteristic odour, and boiling below 105° F. (40°·5 C.). Specific gravity 0·735. Fifty measures agitated with an equal volume of water are reduced to 45, by an absorption of 10 per cent. It evaporates without residue.

Prepare a sample of crude Chloroformum.—$CHCl_3$.

Take of Chlorinated lime, ...	$\frac{1}{2}$ pound.
,, Rectified spirit, ...	$1\frac{1}{2}$ fluid ounces.
,, Slaked lime, ...	a sufficiency.
,, Water, ...	12 ounces.

Place the water and the spirit in a capacious flask, and raise the mixture to the temperature of 100° F. (37°·8 C.). Add the chlorinated lime with half its quantity of the slaked lime, mixing thoroughly. Connect the still with a condensing apparatus encompassed by cold water, and terminating in a narrow-necked receiver; and apply heat so as to cause distillation, taking care to withdraw the fire the moment that the process is well established. When the distilled product measures $2\frac{1}{2}$ ounces, the receiver is to be withdrawn. Pour its contents into a 6-ounce bottle half filled with water, mix well by shaking, and set at rest for a few minutes, when the mixture will separate into two strata of different densities. The lower stratum constitutes crude chloroform.

$$4C_2H_5HO + 8CaCl_2O_2 = 2CHCl_3 + 3Ca2CHO_2 + 5CaCl_2 + 8H_2O.$$

Crude chloroform may be purified by separate agitation first with water, afterwards with an equal volume of pure sulphuric acid, then allowing it to stand over a mixture of quicklime and calcium chloride, decanting and redistilling.

One per cent. of ethylic alcohol is added to chloroform to preserve it.

Type X. The Extraction of Alkaloids (*q.v.*).

Estimate the amount of Morphine in Opium.

[The estimation of morphine in opium is based upon the solubility of morphine in excess of the hydrates of the alkalis and alkaline earths, and its comparative insolubility in ether.]

Take of	Powdered opium, dried at 212° F. (100° C.),	240 grains.
,,	Lime, freshly slaked,	60 grains.
,,	Chloride of ammonium,	40 grains.
,,	Rectified spirit, Ether, Distilled water, of each,	a sufficiency.

Triturate together the opium, lime, and 400 grain-measures of distilled water in a mortar until a uniform mixture results; then add 1000 grain-measures of distilled water and stir occasionally during half an hour (meconates and sulphates precipitated as lime salts, morphine held in solution of "lime-water"). Filter the mixture through a plaited filter about 3 inches in diameter into a wide-mouthed bottle or stoppered flask (having the capacity of about 6 fluid ounces, and marked at exactly 1040 grain-measures) until the filtrate reaches this mark. To the filtered liquid (representing 100 grains of opium) add 110 grain-measures of rectified spirit and 500 grain-measures of ether, and shake the mixture (resins and fat dissolved out); then add the chloride of ammonium, shake well and frequently during half an hour, and set it aside for twelve hours ($2AmCl + Ca2HO = CaCl_2 + 2AmHO$; morphine crystallises out). Counterbalance two small filters; place one within the other in a small funnel, and decant the ethereal layer as completely as practicable upon the inner filter. Add 200 grain-measures of ether to the contents of the bottle and rotate it; again decant the ethereal layer upon the filter, and afterwards wash the latter with 100 grain-measures of ether added slowly and in portions. Now let the filter dry in the air, and pour upon it the liquid in the bottle in portions, in such a way as to transfer the greater portion of the crystals to the filter. When the fluid has passed through the filter, wash the bottle and transfer the remaining crystals to the filter, with several small portions of distilled water, using not much more than 200 grain-measures in all,[1] and distributing the portions evenly upon the filter. Allow

[1] Morphine is slightly soluble in water, viz., 1 in 1500.

the filter to drain, and dry it, first by pressing between sheets of bibulous paper, and afterwards at a temperature between 131° and 140° F. (55° and 60° C.), and, finally, at 194° to 212° F. (96° to 100° C.). Weigh the crystals in the inner filter, counterbalancing by the outer filter. The crystals should weigh 10 grains, or not less than $9\frac{1}{2}$ and not more than $10\frac{1}{2}$ grains, corresponding to about 10 per cent. of morphine in the dry powdered opium.

Estimate of a sample Cinchona Bark for Alkaloids.

Red cinchona (*C. succirubra*) bark for use in galenical preparations should yield between 5 and 6 per cent. of total alkaloids, of which not less than half shall consist of quinine and cinchonidine, as estimated by the following methods:—

1. *For Quinine and Cinchonidine.*—Mix 200 grains of red cinchona bark, in No. 60 powder, with 60 grains of hydrate of calcium; slightly moisten the powders with half an ounce of water; mix the whole intimately in a small porcelain dish or mortar; allow the mixture to stand for an hour or two, when it will present the characters of a moist, dark brown powder, in which there should be no lumps or visible white particles (the alkaloids are thus liberated, insoluble cinchotannate of lime formed). Transfer this powder to a 6-ounce flask, add 3 fluid ounces of benzolated amylic alcohol, boil them together for about half an hour, decant and drain off the liquid on to a filter, leaving the powder in the flask (the alcohol dissolves the liberated alkaloids); add more of the benzolated amylic alcohol to the powder, and boil and decant as before; repeat this operation a third time; then turn the contents of the flask on to the filter, and wash by percolation with more of the benzolated amylic alcohol until the bark is exhausted. If, during the boiling, a funnel be placed in the mouth of the flask, and another flask filled with cold water be placed in the funnel, this will form a convenient condenser which will prevent the loss of more than a small quantity of the boiling liquid. Introduce the collected filtrate, while still warm, into a stoppered glass separator; add to it 20 minims of diluted hydrochloric acid, mixed with 2 fluid drachms of water; shake them well together, and when the acid liquid has separated this may be drawn off (the acid aqueous liquid removes alkaloids from the alcohol, as hydrochlorates), and the process repeated with distilled water slightly acidulated with hydrochloric acid, until the whole of the alkaloids have been removed. The acid liquid thus obtained will contain the alkaloids as hydrochlorates, with excess of hydrochloric acid. It is to be carefully and exactly neutralised with ammonia while warm, and then concentrated to the bulk of

3 fluid drachms. If now about 15 grains of tartarated soda, dissolved in twice its weight of water, be added to the neutral hydrochlorates, and the mixture stirred with a glass rod, insoluble tartrates of quinine and cinchonidine will separate completely in about an hour; and these collected on a filter, washed, and dried, will contain eight-tenths of their weight of the alkaloids, quinine and cinchonidine, which, divided by 2, represents the percentage of those alkaloids. The other alkaloids will be left in the mother-liquor.

2. *For Total Alkaloids.*—To the mother-liquor from the preceding process add solution of ammonia in slight excess. Collect, wash, and dry the precipitate, which will contain the other alkaloids. The weight of this precipitate divided by 2, and added to the percentage weight of the quinine and cinchonidine, gives the percentage of total alkaloids.

Additional Laboratory Work.

All students intending to graduate in medicine should work through the following. For details see the *British Pharmacopœia.*

To examine (*qualitatively*) the following substances for the presence of impurities (the samples being supplied by the demonstrator) :—

Substances.	Impurities.	Tests.
Acaciæ gummi (in powder),	Starch, . . .	Iodine.
Acidum aceticum, . .	Lead, copper, . .	SH_2.
	Sulphuric acid, . .	Barium chloride.
	Sulphurous acid, .	Zinc and HCl, &c.
Acidum phosphoricum, .	Lead, arsenic, . .	SH_2.
	Sulphuric acid, . .	Barium chloride.
	Metaphosphoric acid, .	Albumen.
	Nitric acid, . .	Ferrous sulphate, &c.
	Phosphorous acid, .	Mercuric chloride.
	Calcium salts, . .	Ammonium oxalate.
Ammonii bromidum, .	Bromates, . . .	Sulphuric acid, dilute.
	Iodides, . . .	Starch.
	Sulphates, . . .	Barium, &c.
Aqua destillata, . .	Fixed salts, . .	Evaporation, &c.
	Tin, lead, copper, .	SH_2.
	Calcium salts, . .	Ammonium oxalate.
	Chlorides, . . .	Silver nitrate, &c.
	Sulphates, . . .	Barium, &c.
	Ammonium (more than traces), . . .	Potassio-mercuric iodide.
	Carbonates, . .	Lime-water.

Substances.	Impurities.	Tests.
Bismuthi subnitras, . .	Lead oxynitrate, .	Dilute sulphuric acid.
	Chlorides, . . .	Silver nitrate, &c.
	Arsenium, . . .	Marsh's test.
	Calcium phosphate, .	Citric acid, &c.
	Silver, . . .	HCl.
Copaiba, ...	Fixed oils, yield a .	Soft residue on evap.
	Turpentine, develops characteristic . .	Odour during evap.
	Gurjun balsam (highly fluorescent) is . .	Incompletely sol. in petrol. sp.
Creasotum, . . .	Carbolic acid, . .	Albumen.
		Exposed on filter-paper 212° F.
		Not solidified (HCl and Na_2SO_4, &c.).
		Miscibility with collodion.
Crocus, ...	Heavy insoluble salts, .	Infusion yields no pulverulent sediment.
	Soluble salts, . .	Percentage of ash.
Ferri et quininæ citras, .	Cinchona alkaloids other than quinine are	Incompletely soluble in ether (after ppn. of alkaloids with am.).
Hydrargyri subchloridum,	Fixed salts, . .	Non-volatility.
	Corrosive sub., . .	Ether.
Hydrargyrum cum creta, .	Mercuric oxide, . .	Stannous chloride, &c.
Iodum, ...	Fixed salts, . .	Non-volatility.
	CNI, ...	Slender colourless prisms, &c.
Liquor potassæ, . .	Carbonates, . .	Effervescence with acids.
	Lead, ...	SH_2.
Potassii bromidum, . .	Iodides, . . .	Chlorine and starch.
	Carbonates, . .	Sacch. sol. of lime.
	Sulphates, . . .	Barium, &c.
	Bromates, . . .	Colour with dil. acids.
Potassii iodidum, . .	Iodate, . . .	Tart. acid and starch.
	Chloride, . . .	Silver nitrate, &c.
	Carbonate, . . .	Lime.
Scammoniæ resina, . .	Guaiacum resin, . .	Potatoe-paring.
	Jalap, . . .	Insol. in ether.
Spiritus ætheris nitrosi, .	Deficiency of nitrous compounds, . .	Quantitative determination with nitrometer.[1]
Strychnina, . . .	Brucine, . . .	Nitric acid.
Sulphur sublimatum, .	Arsenic, . . .	Marsh's test.
	Fixed imp., . .	Ignition.
Sulphur præcipitata, .	Calcium sulphate, .	Ignition. Microscope.

[1] $C_2H_5NO_2 + KI + H_2SO_4 = C_2H_5HO + KHSO_4 + I + NO$; *or* $2HI + 2HNO_2 = 2H_2O + 2NO + I_2$. 0·075 grm. $C_2H_5NO_2 = 23·55$ c.c. NO at ordinary temperature and pressure . . . Sp. Æth. Nit. yielding 7 times its volume of nitric oxide, is equivalent to about 3·0 per cent. of nitrous compounds (see page 89).

The following synopsis of practical work, printed from the *Cambridge University Calendar*, 1889, may prove suggestive for further experiment :—

Pharmaceutical Chemistry.

"The examination will be practical, and will have reference to the *chemical principles* involved in—the preparation of *Iodide of Potassium* (*Potassii iodidum*), and the action of dilute acids upon it ; the preparation from ferric oxide of *Reduced Iron* (*Ferrum redactum*) ; the preparation from ferrous sulphate of *Phosphate of Iron* (*Ferri phosphas*) and *Solution of Ferric Sulphate* (*Liquor ferri persulphatis*), and the reaction of ferric salts with iodide of potassium ; the preparation of *Fowler's Solution* (*Liquor arsenicalis*) and the *Hydrochloric Solution of Arsenic* (*Liquor arsenici hydrochloricus*), and the reaction of these solutions with ferric salts ; the preparation from *Chloride of Antimony* (*Liquor antimonii chloridi*), of the *Oxide of Antimony* (*Antimonii oxidum*), and of *Tartar Emetic* (*Antimonium tartaratum*), the detection of oxide of mercury in *Mercury with Chalk* (*Hydrargyrum cum creta*) ; the preparation by sublimation of *Corrosive Sublimate* (*Hydrargyri perchloridum*) and *Calomel* (*Hydrargyri subchloridum*), and the detection by means of ether of the former salt in impure calomel ; the action of an alkaline solution (*Solution of Lime*) on corrosive sublimate and calomel respectively ; the action of *Solution of Ammonia* (*Liquor ammoniæ*) on corrosive sublimate to form *Ammoniated Mercury* (*Hydrargyrum ammoniatum*), and the chief reactions of this compound ; the action of nitric acid on *Bismuth, Bismuthi subnitras*, and the reactions of the salt with water and with ammonia in presence of citric acid ; the preparation of *Sulphide of Calcium* (*Calx sulphurata*), and its reactions with acids and with salts of copper and lead ; the preparation of *Iodoform* (*Iodoformum*) ; the action of alkalis on *Hydrate of Chloral* (*Chloral hydras*) ; the preparation from ferrocyanide of potassium of *Diluted Hydrocyanic Acid* (*Acidum hydrocyanicum dilutum*), its formation from bitter almonds, and the production from it of Prussian blue ; the reaction of *Tannic Acid* (*Acidum tannicum*) with ferric salts, gelatine, and tartar emetic, and the detection of it in *Catechu, Rhatany* (*Krameriæ radix*), or galls (*gallæ*) ; the production of *Conine* (*Conina*) from *Hemlock leaves* (*Conii folia*), and its reaction in aqueous solution with iodine and with tannic acid ; the extraction of *Morphine* from *Opium*, and of the total alkaloids from *Cinchona bark* ; the chief reactions of *Morphine, Quinine, Strychnine, Salicin, Salicylic Acid*, and *Carbolic Acid*."

Additional Laboratory Work[1] for Pharmaceutical Candidates qualifying in Pharmacy.

Volumetric analysis has already been defined as a form of *quantitative* analysis in which an unknown amount of a substance in solution may be ascertained by the determinate action of reagents in solution of known strength, viz., with "volumetric solutions."

The following apparatus is required in the preparation and use of these solutions :—

1. A chemical balance capable of carrying about 50 grms., and turning when loaded to a tenth of a milligramme (fig. 9).

2. A glass flask which, when filled to a mark on the neck, contains 1 litre or 1000 cubic centimetres.

3. A graduated cylindrical jar which, when filled to 0, contains 1 litre (1000 cubic centimetres), and is divided into 100 equal parts.

4. A burette. A graduated tube which, when filled to 0, holds 100 cubic centimetres, and is divided into 100 equal parts.

(One cubic centimetre is the volume of 1 grm. of distilled water at 4° C. (39°·2 F.). 1000 cubic centimetres equal 1 litre.[2])

A *normal* volumetric solution is one so prepared that a litre at 15°·5 C. shall contain the hydrogen equivalent of the active reagent weighed in grammes (Hydrogen = 1) : thus a normal solution of hydrochloric acid contains 36·5 grms. of the acid diluted with water to a litre, and a normal solution of sodium hydrate would contain 40 grms. [H = 1, Cl = 35·5 ; Na = 23, H = 1, O = 16.]

A *decinormal* volumetric solution is $\frac{1}{10}$th the above strength ; a decinormal "solution of soda," for instance, contains 4 grms. of NaHO made up to the litre with water.

Volumetric solutions, before being used, should be shaken, in order that they may be throughout of uniform strength. They should also be preserved in stoppered bottles. All measurements should be made at 60° F. (15°·5 C.).

Indicators of the Termination of Reactions in Volumetric Operations.

Mucilage of Starch.

It gives an intense blue colour with iodine. It may be used with the following substances :—

Acidum Arseniosum.
,, Sulphurosum.
Calx Chlorinata.
Iodum.
Liquor Arsenicalis.
Liquor Arsenici Hydrochloricus.
,, Calcis Chlorinatæ.
,, Sodæ Chlorinatæ.
,, Chlori.
Sodii Hyposulphis.

Solution of Ferricyanide of Potassium.

It gives an intensely blue precipitate with ferrous salts, but none with ferric salts. It is used with the following substances:—

Ferri Arsenias.
,, Carbonas Saccharata.
,, Phosphas.
Ferri Sulphas—
,, ,, Exsiccata.
,, ,, Granulata.

---

[1] To the end of this chapter (Chemical Pharmacy).

[2] It is customary to make the measurements with metric apparatus at 60° F. (15°·5 C.).

Solution of Litmus.

It gives a red colour with acids and a blue colour with alkalis. It may be used with the following substances :—

Acidum Hydrochloricum.	Liquor Potassæ.
,, ,, Dilutum.	,, ,, Effervescens.
,, Nitricum.	,, Sodæ.
,, ,, Dilutum.	,, ,, Effervescens.
,, Nitro-hydrochl. Dil.	Potassa Caustica.
,, Sulphuricum.	Potassii Bicarbonas.
,, ,, Arom.	,, Carbonas.
,, ,, Dil.	,, Citras.
Ammonii Carbonas.	,, Tartras.
Borax.	,, ,, Acida.
Liquor Ammoniæ.	Soda Caustica.
,, ,, Fortior.	,, Tartarata.
,, Calcis.	Sodii Bicarbonas.
,, ,, Saccharatus.	,, Carbonas.

Spiritus Ammoniæ Aromaticus.

Solution of Yellow Chromate of Potassium.

It gives a red colour with nitrate of silver, but not until any soluble bromide or iodide present is entirely decomposed. It may be used with the following substances :—

Ammonii Bromidum.	Potassii Iodidum.
Potassii Bromidum.	Sodii Bromidum.

Sodii Iodidum.

Tincture of Phenol-Phthalein.

It gives an intense red colour with potash or soda. It may be used with the following substances :—

Acetum.	Acidum Aceticum Glaciale.
Acidum Aceticum.	,, Citricum.
,, ,, Dilutum.	,, Tartaricum.

Volumetric Solutions.

I. **Decinormal Oxalic Acid** (6·3 grms. pure $H_2C_2O_4,2H_2O$ per litre).

The following substances are tested with this solution :—

Ammonii Carbonas.	Plumbi Acetas.
Borax.	Potassa Caustica.
Liquor Ammoniæ.	Potassii Bicarbonas.
,, ,, Fort.	,, Carbonas.
,, Calcis.	,, Citras.
,, ,, Sacchar.	,, Tartras.
,, Plumbi Subacet.	,, ,, Acida.
,, Potassæ.	Soda Caustica.
,, ,, Effervcs.	,, Tartarata.
,, Sodæ.	Sodii Bicarbonas.
,, ,, Efferves.	,, Carbonas.

Sodium.

II. Decinormal Caustic Soda (4·0 grms. NaHO per litre).

The following are tested with this solution :—

Acetum.	Acid Lacticum Dil.
Acidum Aceticum.	,, Nitricum.
,, ,, Dilut.	,, ,, Dil.
,, ,, Glac.	,, Nitrohydrochlor. Dil.
,, Citricum.	,, Sulphuricum.
,, Hydrobrom. Dil.	,, ,, Aromat.
,, Hydrochlor.	,, ,, Dilut.
,, ,, Dil.	,, Tartaricum.
,, Lacticum.	

III. Decinormal Silver Nitrate (16·966 grms. $AgNO_3$ per litre).

Acid. Hydrocyan. Dil.	Potassii Cyanidum.
Ammonii Bromidum.	Potassii Iodidum.
Potassii Bromidum.	Sodii Bromidum.

Sodii Iodidum.

IV. Decinormal Potassium Bichromate (14·75 grms. $K_2Cr_2O_7$ per litre).

This solution is used for determining the proportion of ferrous salt in the following preparations. It is known that the whole of the ferrous salt has been converted into a ferric salt when a minute drop of the liquid, placed in contact with a drop of a very dilute solution of ferricyanide of potassium on a white plate, ceases to strike with it a blue colour.

Ferri Arsenias.	Ferri Sulphas.
,, Carb. Sacch.	,, ,, Exsiccata.
,, Phosphas.	,, ,, Granulata.

V. Decinormal Sodium Thiosulphate (24·8 grms. $Na_2S_2O_3,5H_2O$ per litre).

In each case, excepting that of iodum, a solution of iodide of potassium and hydrochloric acid are added to the substance, and the amount of iodine so liberated is indicated by this solution.

Calx Chlorinata.	Liquor Calc. Chlorinatæ.
Iodum.	,, Chlori.

Liquor Sodæ Chlorinatæ.

VI. Decinormal Solution of Iodine (12·65 grms. I per litre).

This solution is used for testing the following substances. It is delivered from the burette into the liquid to be tested, until free iodine begins to appear in the solution.

Acidum Arseniosum.	Liquor Arsenicalis.
,, Sulphurosum.	,, Arsenici Hydrochloricus.

Sodii Hyposulphis.

VOLUMETRIC ANALYSIS.

By means of volumetric test solutions, quantitatively determine the purity of a commercial sample of each of the following compounds and preparations marked with an asterisk. (For details the student should refer to the *British Pharmacopœia* under the "Characters and Tests" of each preparation.)

Method I. By Saturation.

(*a*) Alkalimetry.

Test Solution to be used—Decinormal Solution of Oxalic Acid.

(1) 1 c.c.	=	·0191 grm.	$Na_2B_4O_7,10H_2O$	*Borax.*
,,	=	·0017 ,,	NH_3	*Liquor Ammoniæ.**
,,	=	·0017 ,,	NH_3	,, ,, *Fort.*
,,	=	·0056 ,,	KHO	*Potassa Caustica.**
,,	=	·004 ,,	NaHO	*Soda* ,,

A convenient quantity[1] of the substance to be operated upon having been weighed, it is to be dissolved in, or diluted with, distilled water, so as to constitute about a 1 per cent. solution; a small quantity of an appropriate indicator[2] having been added, the volumetric solution is then cautiously delivered from a burette until the proper change of colour is effected.

(2) 1 c.c.	=	·0069 grm.	K_2CO_3	*Potassii Carbonas.*
,,	=	·0053 ,,	Na_2CO_3	*Sodii Carbonas.**

[1] A convenient quantity may be regarded as such that will require for saturation from 50 to 100 c.c. of a volumetric decinormal solution (or from 10 to 15 of a normal solution). Thus the quantity of borax to be weighed for the saturation of say 60 c.c. $\frac{1}{10}$ N. will be a quantity equal to about a gramme (any other approximate weight will suffice); *e.g.*, (·0191 grm. × 60 = 1·146 grm.); of solution of ammonia such a weight that will contain approximately say ·0017 grm. × 80 = ·136 grm. of NH_3.

[2] A good indicator for alkalimetry is a "Neutral Solution of Litmus," to prepare which digest 1 part litmus with 6 pts. water, filter, divide into two equal parts, add to the one a few drops of H_2SO_4, till the colour just appears red, and then mix it with the other portion. Red with acids; blue with alkalis.

The solution of the salt to be operated upon is placed in a glass flask or beaker, the indicator added, the whole raised to the boiling-point, and throughout ebullition the volumetric solution cautiously added to neutralisation. The application of heat is to eliminate the disengaged CO_2 (which latter, if left in solution, would unduly affect the colour of the indicator, affording erroneous results).

(3)	1 c.c.	=	·012	grm.	$K_2C_4H_4O_6, H_2O$.	*Potassii Tartras.*
	,,	=	·018	,,	$KHC_4H_4O_6$ . .	,, ,, *Acida.**
	,,	=	·0102	,,	$K_3C_6H_5O_7$ . .	,, *Citras.*
	,,	=	·0141	,,	$KNaC_4H_4O_6, 4H_2O$	*Soda Tartarata.**

The weighed quantities of the above are first ignited to dull redness with free access of air, the residual carbonate being estimated as in (2). The two following bicarbonates may likewise be first heated to dull redness and titrated as carbonates (2).

(4)	1 c.c.	=	·01	grm.	$KHCO_3$ . .	*Potassii Bicarbonas.*
	,,	=	·0084	,,	$NaHCO_3$ . .	*Sodii* ,,
	,,	=	·0037	,,	$Ca(HO)_2$ . .	*Liq. Calcis.**
	,,	=	·0037	,,	$Ca(HO)_2$ . .	,, *Saccharatus.*
	,,	=	·0056	,,	KHO . .	*Liq. Potassæ.**
	,,	=	·01	,,	$KHCO_3$ . .	,, *Effervescens.*
	,,	=	·004	,,	NaHO . .	*Liq. Sodæ.*
	,,	=	·0084	,,	$NaHCO_3$ . .	,, *Effervescens.*

Treat as in (1). The effervescent preparations in above are directed to be previously boiled for five minutes. The boiling solution is then titrated as in (2).

(5) 1 c.c. = ·0023 grm. Na, . . . *Sodium.*

The weighed quantity is to be cautiously dissolved in water and titrated as *Liquor Sodæ.*

(6) 1 c.c. = ·00523 grm. $N_3H_{11}C_2O_5$. *Ammonii Carbonas.*

Dissolve weighed quantity in water, add an excess (a measured quantity) of acid test solution, boil for five minutes to eliminate CO_2, and titrate back with the volumetric test solution of soda. [*Sp. Ammoniæ Aromaticus* contains both free ammonia and the neutral carbonate; its saturation may be similarly effected.]

A decinormal test solution of sulphuric acid may be used throughout the above, instead of oxalic acid solution.

(7) For the estimation of :—

(*a*) *Combined Ammonia.*—Treat with caustic potash solution, collect the ammonia evolved, and titrate with acid.

$$1 \text{ c.c. } \tfrac{1}{10} \text{ N. acid} = 0{\cdot}0017 \text{ grm. } NH_3.$$

(*b*) *Alkaline Earths.*—Dissolve in a known quantity of HCl and titrate back the excess of acid ; in like manner their carbonates.

1 c.c. $\frac{1}{10}$ N. acid	= 0·00855 grm.	$Ba(OH)_2$	= 0·00765 grm.	BaO.
	= 0·0037 ,,	$Ca(OH)_2$	= 0·0028 ,,	CaO.
	= 0·0098 ,,	$BaCO_3$		

(*c*) *Magnesia* and all salts convertible into magnesia or its carbonate may be dissolved in a known quantity of sulphuric acid and titrated back.

(*d*) *Zinc, Copper, Silver, Lead, Bismuth, Nickel, Cobalt, Iron, Mercury, Manganese, and Chromium* may be determined by precipitating with volumetric Soda or Potash, the oxides of these bodies, and estimating with acid the excess of alkali in the filtrate, whereby the acid as well as the base may be calculated.

(*b*) Acidimetry.

Test solution to be used—Decinormal solution of soda.

1 c.c.	= ·006 grm.	$HC_2H_3O_2$	*Acetum.*
			*Acidum Aceticum.**
			,, ,, *Dilutum.*
			,, ,, *Glaciale.*
,,	= ·007 ,,	$H_3C_6H_5O_7,H_2O$	,, *Citricum.*
,,	= ·0081 ,,	HBr	,, *Hydrobrom. Dilut.*
,,	= ·00365 ,,	HCl	,, *Hydrochloricum.*
			,, ,, *Dilut.*
,,	= ·0078 ,,	$HC_3H_5O_3$	,, *Lacticum.*
			,, ,, *Dilut.*
,,	= ·0063 ,,	HNO_3	,, *Nitricum.*
			,, ,, *Dilut.*
	(*vide* Ph. B.)		,, *Nitrohydrochlor. Dilut.*
,,	= ·0049 ,,	H_2SO_4	,, *Sulphuricum.*
			,, ,, *Aromat.*
			,, ,, *Dilut.**
,,	= ·0075 ,,	$H_2C_4H_4O_6$	,, *Tartaricum.**

Acids in the free state, the more concentrated being first properly diluted with water, are determined by direct saturation. Acids in combination may be determined as stated under alkalimetry (7, *d*).

For the above organic acids "solution of phenol-phthalein" may be used as an indicator.

Method II. By Precipitation.

(*a*) Test solution to be used—Decinormal solution of nitrate of silver.

1 c.c.	= ·013 grm.	KCy	*Potassii Cyanidum.**
,,	= ·0054 ,,	HCy	*Acid. Hydrocyan. Dil.**
			*Aqua Laurocerasi.**
,,	= ·0098 ,,	NH_4Br	*Ammonii Bromidum.**
,,	= ·0119 ,,	KBr	*Potassii* ,,
,,	= ·0103 ,,	NaBr	*Sodii* ,,
,,	= ·0166 ,,	KI	*Potassii Iodidum.**
,,	= ·015 ,,	NaI	*Sodii* ,,

With the last five of the above preparations "solution of potassium chromate" may be used as an indicator; after complete precipitation of the salts in question, a yellowish-red precipitate (of silver chromate) commences to be formed.

The hydrocyanic acid to be operated upon is first converted into a cyanide by the addition of solution of potash or soda. No indicator is required, since, by the addition of $AgNO_3$ to the solution of cyanide a *soluble* double cyanide (AgCy, NaCy) is formed until half of the cyanide is combined with the silver; the further addition of any $AgNO_3$ beyond this stage causes the production of a permanent precipitate of AgCy, thus terminating the operation. ($AgCy,NaCy + AgNO_3 = 2AgCy + NaNO_3$). According to Siebold, the quantity of solution of soda to be added should be just sufficient to effect saturation, and the resulting liquid should be diluted with water to at least ten times the volume of the acid used.

(*b*) Test solution to be used: $\frac{1}{10}$ N. Oxalic Acid.

1 c.c. = ·01895 grm.	$Pb2C_2H_3O_2,3H_2O$	. .	*Plumbi Acetas.**
,, = ·0137 ,,	$Pb_2O2C_2H_3O_2$	. .	*Liq. Plumbi Subacet.**

The termination of the reaction is ascertained by the precipitate ceasing to be formed.

(*c*) Estimation of sugar with Fehling's solution.

(1) Dissolve 34·64 grms. $CuSO_4,5H_2O$ in water and dilute to 500 c.c.

(2) Disolve 173 grms. $KNaC_4H_4O_6,4H_2O$ and 50 grms. NaHO in water, dilute to 500 c.c.

Equal bulks of solutions (1) and (2) are mixed as required for analysis. The titration is made thus—10 c.c. of the mixed solution (Fehling's) is diluted with five to ten volumes of water and boiled in a white porcelain dish on a wire gauze support under a burette containing the solution of sugar (about ·5 per cent.) to be tested; while the diluted copper solution is boiling, gradually run in the sugar solution until all the cuprous oxide is precipitated and the supernatant liquid [1] has assumed a yellowish colour (best seen by tilting the dish), indicating the termination of the reaction.

10 c.c. Fehling's Solution = ·05 grm. Glucose.
,, ,, ,, = ·0475 ,, Cane-Sugar.[2]

(*d*) The estimation of alkaloids by solution of potassio-mercuric iodide (Mayer's Solution). This solution, as prepared by Prof. Mayer, was of decinormal ($\frac{1}{10}$ N.) strength; for use, a solution half this strength is preferable ($\frac{1}{20}$ N.), prepared by dissolving *Mercuric chloride*, 6·775 grms., and *Potassium iodide*, 25·0 grms., in water and diluting to 1 litre.

---

[1] A small quantity may be removed with a pipette and further tested for copper by the addition of acetic acid and potassium ferrocyanide, the absence of a brown coloration indicating the termination of the reaction.

[2] By the action of dilute acids (*e.g.*, HCl) at 70° C., 96 parts of pure cane-sugar give 100 parts of inverted sugar—to be titrated after neutralisation of the solution with solution of caustic soda.

"Mayer's solution is applied only in acidulous solutions in testing for alkaloids; therefore ammonia does not interfere, as the precipitate of mercurammonium iodide is not formed in presence of free acids. The acidulation may be with sulphuric or hydrochloric acid, and may be strong

Alkaloid.	Strength of Alkaloidal Solution.	C.c. of Reagent required to produce apparent excess.	C.c. of Reagent required for complete precipitation.	Excess of Reagent at end of experiment.	1 c.c. of Reagent precipitates of alkaloid (gramme).	Weight of precipitate collected immediately and dried at 100° C.
Aconitine, .	1:200	...	7·1	2·	·0141	·180–·190
Atropine, . .	1:200	7·	13·1	3·	·0077	·216–·220
Atropine, . .	1:400	6·	14·	3·5	·0072	...
Atropine, . .	1:600	6·	15·	5·6	·0067	...
Berberine, .	1:200	...	3·8	...	·0263	·192–·200
Berberine, .	1:400	...	3·9	...	·0257	...
Berberine, .	1:600	...	4·6	...	·0218	...
†Brucine, . .	1:200	...	8·	1·7	·0125	·200–·215
†Brucine, . .	1:400	...	8·8	...	·0114	...
‡Brucine, . .	1:400	...	9·8	...	·0102	...
†Brucine, . .	1:600	...	9·2	...	·0109	...
Cinchonidine,	1:100	12·4	13·8	1·0	·0073	...
Cinchonidine,	1:200	12·4	13·5	0·7	·0074	·330–·375
Cinchonidine,	1:200	...	15·6	2·6	·0064	...
Cinchonine, .	1:100	...	12·8	0·8	·0078	...
Cinchonine, .	1:100	...	14·	1·2	·0072	...
*Cinchonine,	1:200	7·9	10·8	...	·0093	·333–·345
‡Cinchonine, .	1:200	8·	14·2	...	·0071	...
*Cinchonine, .	1:400	8·	12·4	2·4	·0082	...
‡Cinchonine, .	1:400	9·6	14·–18·	...	·007 to ·0086	...
Cocaine, . .	1:200	...	12·8	...	·0078	·246
Cocaine, . .	1:400	10·	14·4	4·6	·0069	...
Cocaine, . .	1:600	...	16·	5·2	·0063	...
Colchicine, .	1:200	3·2	9·2	...	·0109	·160‡
Colchicine, .	1:400	4·2	11·4	...	·0088	...
Colchicine, .	1:600	5·	12·6	...	·0080	...
Colchicine, .	1:800	4·	14·6	...	·0067	...
Emetine, . .	1:200	8·	9·4	0·4	·0106	·256‡
Emetine, . .	1:400	8·8	10·2	1·	·0098	...
Emetine, . .	1:600	...	10·6	0·6	·0094	...
Gelsemine, .	1:200	5·8	10·4	...	·0096	·185–·200
Gelsemine, .	1:400	6·5	12·	...	·0084	...
Hydrastine, .	1:200	...	7·4	...	·0135	·200–·210
Hydrastine, .	1:400	...	8·	...	·0125	...
Hydrastine, .	1:600	...	8·4	...	·0119	...
Hyoscyamine,	1:200	...	8·5	...	·0116	·220–·250
Morphine, . .	1:200	7·	9·1	...	·0128	·190–·204
Morphine, . .	1:400	...	8·9	0·6	·0110	...
Pilocarpine, .	1:200	4·8	16·8	...	·0060	·240–·340
Pilocarpine, .	1:200	...	20·	...	·0050	...
*Quinine, . .	1:200	11·6	16·4	...	·0061	...
‡Quinine, . .	1:200	12·4	18·	...	·0056	·310–·335
Quinine, . .	1:400	12·8	16·8	...	·0060	...
Quinine, . .	1:600	12·2	20·	...	·0050	...
Strychnine, .	1:200	...	11·	0·6	·0091	·260–·275
*Strychnine, .	1:400	11·6	12·	...	·0084	...
‡Strychnine, .	1:400	11·6	12·2	...	·0082	...
Strychnine, .	1:600	11·2	11·9	0·6	·0087	...

* Neutral. † Nearly neutral. ‡ Acid.

without dissolving the precipitate. The solution tested must not be alcoholic, and must not contain acetic acid. Some organic matters other than alkaloids cause precipitates. With strychnine the precipitate is even

obtainable in dilution of 1 to 150,000; with quinine, in solutions of about the same dilution; while with morphine, or with atropine, solutions of 1 to 4000 do not give the precipitate. The precipitates are curdy or flocculent, and for the most part of a yellowish-white colour" (Prescott's *Organic Analysis*).

"Crude material may be extracted with water acidulated with sulphuric acid, and in many cases the estimation may be made in this liquid without further treatment. But if the presence of mucilaginous substances, &c., prevent this, and their partial removal by alcohol be necessary, the solution must be completely freed from spirit before titrating. The termination of the reaction is usually found by a drop of the filtered solution yielding no precipitate with a drop of the reagent" (Dragendorff's *Plant Analysis*).

The manner in which the titration is best conducted is as follows:—Put the solution to be titrated into a test-tube, having noted its volume. Run into it from a burette the reagent (N. $\frac{1}{20}$) as long as it produces a dense precipitate, or until about one-half the quantity necessary to complete the precipitation has been added. Filter into a second test-tube, selecting a filter which will hold the whole of the fluid at the end of the titration, but not much more. As soon as a sufficient quantity of fluid has filtered through clear set the funnel in test-tube No. 1, and cautiously add a drop or two of the reagent to the clear fluid; if a dense precipitate is produced, add 5 to 10 drops of the reagent, and return to the filter, using the fluid that has filtered meantime into the first test-tube to rinse out the second. Proceed in this way until the precipitation begins to be scanty. When nearing the end of the experiment allow nearly the whole of the fluid to filter through before adding more reagent, and filter twice if necessary to secure a perfectly clear fluid. Except in the case of a few alkaloids there is no difficulty about obtaining a clear filtrate, and the filtration is very rapid (*Lyons*).

The table on the preceding page represents the result of a series of experiments conducted by A. B. Lyons (*Pharmaceutical Assaying*, p. 28), affording useful data on the precipitation of various alkaloids by Mayer's reagent (N. $\frac{1}{20}$), 0·1 grm. of alkaloid being used in each determination.

Hereth's method of titrating with Mayer's reagent is as follows:—"Knowing approximately the alkaloidal strength of the solution to be examined, provide half a dozen or more of test-tubes or phials, into each of which measure 10 c.c. of the solution. To the first is added a quantity of Mayer's reagent, which is thought to be a little less than enough for the precipitation; to the second is added a quantity of reagent 5 per cent. greater, to the next a quantity 10 per cent. greater, and so on. Let the test-tubes stand at least eight hours; then test a portion of the clear supernatant fluid from each with two drops of the reagent. Among them there will be some which react strongly, others which do not respond at all. The first one which fails to react obviously has received of the reagent a little more than enough, and the amount of precipitate produced in the one preceding it in this series will enable us to fix quite accurately the point at which precipitation would have ceased had the titration been conducted in the usual manner.

If this method is to be adopted it will be necessary, of course, to fix the value of the equivalent for each alkaloid empirically by experiments carried out in the same manner, and these would no doubt be found different from those given by previous observers who have followed a different mode of procedure" (Lyons' *Pharmaceutical Assaying*).

Method III. By Oxidation.

(*a*) Test solution to be used—Decinormal solution of potassium bichromate.

1 c.c.	=	·0168	grm.	Fe	*Ferrum.**
,,	=	·0446	,,	Fe_32AsO_4	*Ferri Arsenias.**
,,	=	·0348	,,	$FeCO_3$	,, *Carb. Sacch.*
,,	=	·0358	,,	Fe_32PO_4	,, *Phosphas.*
,,	=	·0456	,,	$FeSO_4$	,, *Sulphas.**
,,	=	·0456	,,	$FeSO_4$	,, ,, *Exsicc.*
,,	=	·0456	,,	$FeSO_4$	,, ,, *Granulat.*

In the estimation of *Ferrum*, it is first converted into $FeSO_4$ by solution in excess of dilute sulphuric acid, any ferric salt present being reduced by immersing in the solution a piece of zinc bound round with platinum wire; no red coloration should be produced on adding a drop of potassium sulphocyanate; $6FeSO_4 + 7H_2SO_4 + K_2Cr_2O_7 = K_2SO_4{,}Cr_23SO_4 + 7H_2O + 3Fe_23SO_4$. The above remaining preparations are each likewise dissolved in excess of dilute sulphuric acid previous to titration.

A volumetric "solution of potassium permanganate" ($\frac{1}{10}$ N.) may be used for testing the above instead of solution of potassium bichromate.

(*b*) Test solution to be used—Decinormal sodium thiosulphate.

1 c.c.	=	·0127	grm.	I	*Iodum.**
,,	=	·00355	,,	Cl.	*Calx Chlorinata.**; *Liq. Calcis Chlorinat.*; ,, *Chlori.*; ,, *Sodæ Chlorinat.*

By the action of iodine on sodium thiosulphate, the colourless compounds sodium iodide and sodium tetrathionate are formed :—

$$2I + 2Na_2S_2O_3 = 2NaI + Na_2S_4O_6 .$$

The available chlorine in the above chlorinated preparations is liberated by the addition of dilute hydrochloric acid in the presence of potassium iodide, the iodine thus set free being then estimated.

(*c*) Test solution—Decinormal iodine.

1c.c.	=	·0032	grm.	SO_2 (or ·0041 grm. H_2SO_3)	*Acidum Sulphurosum.*
,,	=	·00495	,,	As_2O_3	,, *Arseniosum.**
,,	=	,,	,,	,,	*Liq. Arsenicalis.*
,,	=	,,	,,	,,	,, *Arsenici Hydrochl.**
,,	=	·0248	,,	$Na_2S_2O_3{,}5H_2O$	*Sodii Hyposulphis.**

With arsenious acid, the reaction is incomplete in acid solutions, upon which account the addition of alkali is necessary ($As_2O_3 + I_4 + 4NaHCO_3 = As_2O_5 + 4NaI + 4CO_2 + 2H_2O$). For this purpose a little sodium bicarbonate may be added (to super-

saturation), the resulting liquid being boiled until solution is effected, then cooled and titrated.

The Assaying of Drugs.

The following is an apparatus (fig. 46) for the automatic extraction and exhaustion of vegetable and animal substances by means of hot volatile solvents, *e.g.*, petroleum ether, carbon disulphide, ether, chloroform, amylic or ethylic alcohol, &c. The middle portion of the apparatus (containing A and B) is a Soxhlet's tube (readily obtainable from chemical apparatus dealers), connected above with a Liebig's condenser E (reflux) below, with a flask C containing the solvent. D is a water-bath; B is a plug of asbestos resting on the hermetically sealed base of the tube, A is the powdered substance to be operated upon; the volatile vapours ascending through F are condensed in E (which is open to the air at the top), the resulting liquid drops upon A, there accumulates, the impregnated liquid becoming automatically syphoned off, G into C. When only a small quantity of a drug is to be operated upon, it may be introduced into a test-tube having a perforation at its bottom (loosely plugged with asbestos), and the whole introduced in such a manner as to occupy the space A. When in use the slender tube F should be wrapped round with a long strip of lint fastened with twine. Fig. 47 is a Will's water-bath and drying-oven combined, suitable for use in the following operations; the side-box is a hot-air chamber for drying test-tubes, &c.

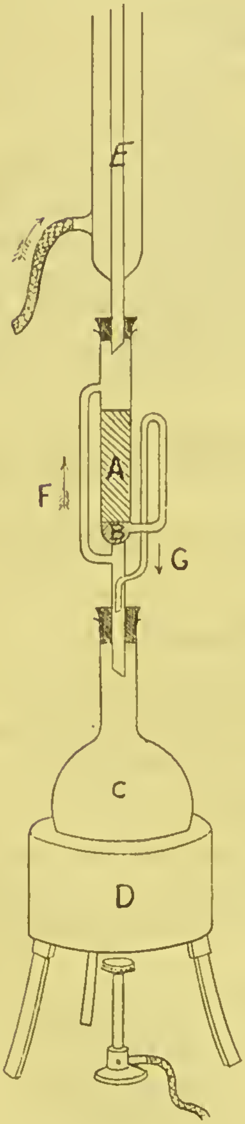


FIG. 46.

I. *Assay a sample of Saffron for* (1) *Moisture and* (2) *Ash.*

1. Heat from 3 to 5 grms. of saffron in a small tared (weighed) dish placed in water-oven until it ceases to lose weight. Weigh.[1]

2. Incinerate the dried residue in a tared platinum dish; allow to cool and immediately weigh.

[1] In calculating the percentage, a deduction of 1 per cent. must be made, since saffron contains that amount of *volatile oil.*

Each entire portion of commercial saffron is an inch or somewhat more in length ; it consists of three thread-like orange-red stigmas, thickened and tubular above, and jagged or notched at their extremities, and united below to the top of the yellow style. It is flexible, unctuous to the touch, with a peculiar strong aromatic odour, and a bitter somewhat aromatic taste. Rubbed on the wet finger it leaves an intense orange-yellow tint. When pressed between folds of white filtering-paper, it leaves no oily stain. When a small portion is placed in a glass of warm water it colours the liquid orange-yellow, but should not deposit any white or coloured powder (saffron is sometimes fraudulently loaded with barium or lead sulphate). Ignited with free access of air, it yields about 6 per cent. of ash.

Attention has recently been called by H. Adrian (*Jour. de Pharm. et de Chim.*, Feb. 1889) to the adulteration of a sample of saffron with *soluble* salts. It was found to yield 26·4 per cent. of ash consisting chiefly of borate,

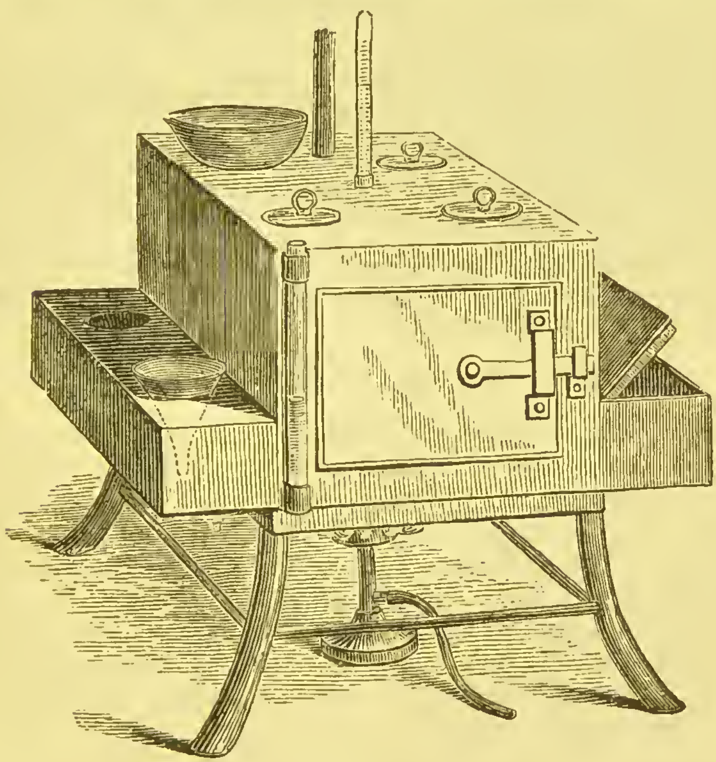


FIG. 47.

chloride and sulphate of sodium, and carbonate of potassium. The saffron also contained ammonium nitrate. The potassium found in the ash as carbonate was present in the saffron as tartrate. Similar adulteration of saffron has also been observed by E. M. Holmes (*Pharm. Jour.* (3), xix. 666). The sample was of excellent colour and odour ; when placed in water it immediately yields an orange-yellow colour. True saffron under the same circumstances yields a lemon-yellow tint more slowly.

When heated in a platinum crucible, as soon as it takes fire it deflagrates like touch paper, indicating the presence of a nitrate. The ash in the crucible

quickly fuses, whereas in the case of true saffron the ash retains the form of the saffron filaments.

The presence of a nitrate in the infusion can be confirmed by the sulphate of iron and sulphuric acid test. This saffron was found to contain 15·13 per cent. of moisture, being above the average (12 per cent.). *Yearbook of Pharmacy*, 1889, p. 158.

II. *Assay a sample of Manna for Mannite.*

1. Estimate the moisture in from 3 to 5 grms. as in I.

2. Reduce the dried residue to powder, boil with 50 c.c. of alcohol[1] sp. gr. ·838, filter, wash the residue with a little additional boiling alcohol, and set the combined filtrate aside to become cold. Separate the deposited crystals upon a tared filter, dry at about 40° C., and weigh.

Manna consists principally of mannite, $C_6H_8(HO)_6$, together with common sugar and indefinite matter. The mannite, which forms from 60 to 80 per cent. of the manna, may be extracted by boiling with fifteen or sixteen parts of rectified spirit, from which it will afterwards separate on cooling in colourless, shining crystals; it requires five parts of cold water for its solution, and this does not undergo vinous fermentation in contact with yeast. Manna contains about 10 per cent. of moisture and yields about 3·6 per cent. of ash. The residue of the manna undissolved by alcohol should not be viscid (natural manna leaves undissolved a hard substance). (Fluckiger and Hanbury, *Pharmacographia*, p. 414.)

III. *Assay* 30 *grms. of Jalap for Total Resin.*

Reduce the jalap to No. 40 powder, digest with 60 c.c. of rectified spirit in a covered vessel, heating gently for twenty-four hours; then transfer to a small percolator, and, when the tincture ceases to pass, continue the percolation with more spirit until it ceases to dissolve anything. Add to the tincture 30 c.c. of water, and distil off the spirit by a water-bath. Remove the residue while hot to an open dish, and allow it to become cold. Pour off the supernatant fluid from the resin, wash this two or three times with hot water, and dry it on a porcelain plate by the heat of a stove or water-bath. Weigh.

Scammony root may be assayed in a similar manner.

[1] In the assaying of drugs purified methylated spirit of like specific gravity may be used in the place of the more expensive ethylic alcohol (in all its dilutions). Methylated spirit (so-called commercial methylic alcohol) being a mixture of one part of purified wood-spirit with nine parts of rectified spirit contains besides methylic and ethylic alcohols, varying proportions of acetaldehyde, acetone, fusel-oil and water. It may be freed from acetone and aldehyde by boiling with 3 to 4 per cent. solid caustic potash on a water-bath with reflux condenser for an hour, and then distilling off on a water-bath. It is rendered absolute (*i.e.*, freed from water) by distilling once or twice over fresh quicklime.

IV. *Assay from ·75 to 1 grm. of Extract of Nux Vomica* (Ph. B.) *for Total Alkaloids.*

Dissolve the extract in 15 c.c. of water, heating gently if necessary, and add 4 grms. of carbonate of sodium previously dissolved in 15 c.c. of water (alkaloids liberated) and 15 c.c. of chloroform; agitate, warm gently, and separate the chloroform. (Chloroform dissolves the alkaloids together with other extractive matter.) Add to this 15 c.c. of dilute sulphuric acid with an equal bulk of water; again agitate, warm, and separate the acid liquor from the chloroform (the acid aqueous layer contains the alkaloids as salts, the extractive colouring matter being left in the chloroform). To this acid liquor add now an excess of ammonia (alkaloids are precipitated), and agitate with 15 c.c. of chloroform (the chloroform dissolves the alkaloids); when the liquors have separated, transfer the chloroform to a weighed dish, and evaporate the chloroform over a water-bath. Dry the residue of total alkaloids for one hour, and weigh.

[The menstruum used for the extraction of the crude seed is a mixture of 4 vols. of rectified spirit with 1 of water.]

V. *Prepare a sample of Santonin* (Ph. B.).

Bruise 30 grms. of santonica, boil with 300 c.c. of distilled water and 20 grms. of slaked lime for one hour, and strain through strong calico with pressure. Allow the strained liquid to settle, decant the clear supernatant liquid and evaporate to the volume of about 90 or 100 c.c. (this liquid contains a soluble compound of santonin with lime). To the liquor while hot, add, with diligent stirring, hydrochloric acid until the fluid has become slightly and permanently acid, and set it aside for a few days that the precipitate may subside (santonin is precipitated, calcium chloride in solution). Remove, by skimming, any oily matter which floats on the surface, and carefully decant the greater part of the fluid from the precipitate. Collect this on a paper filter, wash it first with cold distilled water till the washings pass colourless and nearly free from acid reaction, then with 8 minims of weak solution of ammonia previously diluted with about 10 c.c. of water (to remove last traces of acid), and lastly with cold distilled water till the washings pass colourless. Press the filter containing the precipitate between folds of filtering-paper, and dry it in a warm place. Scrape the dry precipitate from the filter, and mix it with 0·5 grm. animal charcoal. Add to the mixture 20 c.c. of rectified spirit, digest for half an hour, and boil for ten minutes. Filter while

hot, wash the charcoal with an additional 10 c.c. of boiling spirit, and set the filtrate aside for two days in a cool dark place to crystallise. Separate the mother-liquor from the crystals, and concentrate to obtain a further product. Collect the crystals, let them drain, redissolve them in boiling spirit, and let the solution crystallise as before. Lastly, dry the crystals on filtering-paper in the dark, and preserve them in a bottle protected from light.

VI. *Assay* 20 *grms. of Belladonna Root for Alkaloids—Hyoscyamine and Atropine.*

"Twenty grams of the dry and finely-powdered root are exhausted by hot percolation with a mixture of equal parts by volume of chloroform and absolute alcohol; if an extraction apparatus is used about 60 c.c. of the mixture is required. The percolate is agitated with two successive 25 c.c. of distilled water, which are separated in the usual way (the water withdraws spirit accompanied with alkaloids—the author). These are mixed and well agitated with chloroform to remove the last traces of mechanically adherent colouring matter. The chloroform is separated, the aqueous liquid rendered alkaline with ammonia and agitated with two successive 25 c.c. of chloroform, which are separated, mixed, and agitated with a small quantity of water (rendered faintly alkaline with ammonia) to remove adherent aqueous liquid. The chloroform is then evaporated over a water-bath until the weight of the atropine and hyoscyamine is constant, which usually occupies a little less than one hour" (Dunstan and Ransom, *Pharm. Jour.* (3), vol. xiv. p. 625).

VII. *Assay* 250 *grms. of Aconite Root for Aconitine* (*Aconitia* Ph. B.).

Reduce the root to coarse powder, mix with twice its weight of alcohol sp. gr. ·838, and apply heat until ebullition commences; then cool and macerate for four days. Transfer the whole to a displacement apparatus, and percolate, adding more spirit, when requisite, until the root is exhausted (alkaloidal salt, resin, and colouring matter extracted). Distil off the greater part of the spirit from the tincture, and evaporate the remainder over a water-bath until the whole of the alcohol has been dissipated. Mix the residual extract thoroughly with twice its weight of boiling distilled water, and when it has cooled to the temperature of the atmosphere, filter through paper (resinous matter left behind). To the filtered liquid add solution of ammonia in slight

exeess, and heat them gently over a water-bath. Separate the precipitate on a filter, and dry it (crude alkaloid). Reduce this to coarse powder, and macerate it in successive portions of pure ether, with frequent agitation (colouring matter left behind). Decant the several products, mix, and distil off the ether until the extract is dry (residue, purified alkaloid). Dissolve the dry extract in warm, distilled water, acidulated with sulphuric acid; and, when the solution is cold, precipitate it by the cautious addition of solution of ammonia, diluted with four times its bulk of distilled water. Wash the precipitate on a filter with a small quantity of cold distilled water, and dry it by slight pressure between folds of filtering-paper and subsequent exposure to air. Weigh.

VIII. *Assay a sample of Tea for Caffeine.*

"For this purpose 5 grms. of powdered tea is moistened with hot water, well mixed with 1 grm. of slaked lime, and the whole dried on a water-bath. The dry residue is then transferred to a small percolating apparatus, and extracted with strong alcohol. The clear liquor is to be evaporated to remove alcohol, and the remaining water solution, measuring about 50 c.c., mixed with a few drops of dilute sulphuric acid, which separates a trace of lime and partially decolorises the liquid. After filtering the slightly acid solution, it is transferred to a separator and well shaken with chloroform, which gradually abstracts the theine. This part of the operation requires particular care, for though theine is freely soluble in chloroform it is necessary to shake the acidified water solution with several successive quantities of chloroform in order to remove the whole of the theine. Unless the quantity of theine is very large, about 200 c.c. of chloroform will be sufficient for 5 grms. of tea, and that should be used in five or six separate portions, testing the last portions by distilling off the chloroform in a weighed flask, until it is found that there is no more theine taken up. The whole of the chloroform solution is then to be placed in a stoppered separator, and shaken with a very dilute solution of caustic soda. This will remove a small quantity of colouring matter and render the theine solution quite colourless, so that on distilling off the chloroform from a weighed flask the theine remains in a condition fit for weighing. When the operation is carefully carried out the theine will be perfectly white" (Paul and Cownley, *Pharm. Jour.* (3), vol. xviii. 417).

The determination of caffeine in raw "coffee" and in "guarana" may be performed in a similar manner.

IX. *Assay a sample of Ipecacuanha for Emetine.*

"2·5 grms. of ipecacuanha root reduced to fine powder are introduced into a small cylindrical percolator about 200 mm. long, and 11 to 12 mm. internal diameter, very lightly shaken down, and a loose plug of cotton-wool placed on the surface of the powder. 10 c.c. of acetic ether are now poured on and allowed to soak through the powder, care being taken to observe if any air spaces or channels exist in any portion. When the fluid begins to drop from the percolator, the *upper* open end is securely corked to prevent any further flow of the liquid, and the whole allowed to macerate for about two hours, or preferably over night. Percolation is then proceeded with until about 50 c.c. of percolate is obtained or the root is exhausted; this is the case if 6 to 10 drops of the liquid, when evaporated, and the residue dissolved in dilute sulphuric acid, give no precipitate with Mayer's solution.

"The solution thus obtained is introduced into a separator, and washed with *four* successive quantities of slightly acidulated water (about 8 c.c. at a time). The aqueous liquid now containing the emetine is washed once with ether while still acid, then rendered alkaline with ammonia, and washed *three* times with 6 c.c. of ether, followed by two successive washings with 6 c.c. of chloroform. The mixed ethereal and chloroformic solutions are washed once with water, then evaporated in a current of air, and dried by exposure over sulphuric acid for some hours; it is then weighed, dissolved with 20 c.c. of water acidulated with 6 drops of 5 per cent. (by volume) sulphuric acid, in which it should be almost entirely soluble, and titrated with Mayer's solution ($\frac{1}{20}$ N.) in the usual manner: 1 c.c. = 0·00945 grm. emetine" (Cripps and Whitby, *Pharm. Jour.* (3), xix., 721; *Yearbook of Pharmacy*, 1889).

X. *Assay a sample of Cantharides for Cantharidin.*

"25 grms. of the powdered flies are exhausted by treatment with petroleum ether in a percolator or Soxhlet's tube. The solvent should be limited to 100 c.c. measure, and a correction of 0·0108 grm. of cantharidin made for the slight solubility of the principle in the liquid. The flies thus freed from fat are now thoroughly moistened with solution of soda, and the mixture dried at 100° C. Much ammonia is evolved, and a soluble cantharidate of sodium formed. The dried mass is finely powdered and transferred to a separator, where it is treated with excess of dilute hydrochloric acid, and the liberated cantharidin extracted

from the aqueous liquid by agitation with a mixture of equal measures of ether and chloroform; the ether-chloroform is separated, and the agitation repeated with a fresh quantity till the extraction is complete. The ether-chloroform is evaporated to dryness at a gentle heat, and the residue weighed. The crude cantharidin thus obtained may be transferred to a small tared filter, and washed with a little *absolute* alcohol, and then with 2 or 3 c.c. of water. Any remaining traces of oil may be removed by a little petroleum ether. If the washing with alcohol and water be employed, the volumes used must be noted and a correction made of ·00077 grm. for each 1 c.c. of alcohol, and ·00050 for each 1 c.c. of water" (H. G. Greenish, *Pharm. Jour.* (3), x. 729; Allen's *Organic Analysis*, vol. ii. p. 451).

Miscellaneous.

XI. *Assay a sample of Sp. Ætheris Nitrosi for Nitrous Compounds.*

"The nitrometer should be filled with strong brine, and 5 c.c. of the sample to be tested should then be placed in the cup of the nitrometer, and allowed to enter through the tap, taking care that no air gets in at the same time. 5 c.c. of a strong solution of potassium iodide is next allowed to enter, and this is followed by about 5 c.c. of dilute sulphuric acid. Effervescence immediately ensues, and, if the tube be vigorously agitated at intervals, the reaction is complete in five minutes, when the level of the liquid in the two limbs of the nitrometer is adjusted, and the volume of nitric oxide gas read off. If the volume of gas evolved be small, another 5 c.c. of the sample should be let into the nitrometer, and the agitation repeated" (Allen, *Yearbook of Pharmacy*, 1885). See page 70.

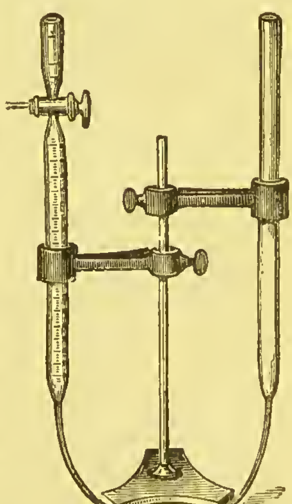


Fig. 48.—A Nitrometer.

For medicinal use a 2 per cent. solution of ethyl nitrite in absolute alcohol is recommended, the stability of which may be further increased by the addition of 5 per cent. of glycerine, which has an appreciable influence owing to its hygroscopic properties in preventing the decomposition of ethyl nitrite. A solution in weaker alcohol or rectified spirit is unstable.

XII. (1) *Using* 1 *fl. oz. of "Strong Solution of Perchloride of Iron" prepare a sample of "Liq. Ferri Dialysatus"* (*Brit. Pharm.*). [Cf. *Dialysis.*]

A dialyser may be extemporised with a glass globe (provided it has a basal rim) off a gas-chandelier.

(2) *Determine the melting-point of* (*a*) "*Cera Flava,*" (*b*) "*Paraffinum Durum.*" [Cf. *Melting-Point.*]

(3) *Crush a grain of* (*a*) *Wheat,* (*b*) *Maize,* (*c*) *Rice; place each in a test-tube, dilute with water, and examine their forms of starch grain under the microscope.*

1. Wheat starch: A mixture of large and small granules, which are lenticular in form, and marked with faint concentric striæ surrounding a nearly central hilum. 2. Maize starch: Granules more uniform in size, frequently polygonal, somewhat smaller than the large granules of wheat starch, and having a very distinct hilum but without evident concentric striæ. 3. Rice starch: Granules extremely minute, nearly uniform in size, polygonal, hilum small and without striæ.

Run under the cover-slip a drop of very dilute iodine solution.

PART II.

GALENICAL PHARMACY.

Under this heading we have for consideration the manipulation and processes by which the pharmacopœial crude vegetable and animal substances are prepared for medicinal use.

The galenical products or preparations thus obtained, vary according to the processes to which these substances have been submitted. The pharmacopœial galenical preparations may be classified under the following groups (the figures representing the number of preparations in each).

Aceta.—Vinegars (2).
Aquæ.—Waters (16).
Cataplasmata.—Poultices (6).
Chartæ.—Papers (2).
Collodia.—Collodions (3).
Confectiones.—Confections (8).
Decocta.—Decoctions (13).
Emplastra.—Plasters (14).
Enemata.—Clysters (6).
Essentiæ.—Essences (2).
Extracta.—Extracts (47).
Glycerina.—Glycerines (8).
Infusa.—Infusions (28).
Injectiones.—Injections (3).
Lamellæ.—Discs (3).
Linimenta.—Liniments (16).
Liquores.—Solutions (48).
Mellita.—Honeys (2).
Misturæ.—Mixtures (10).
Mucilagines.—Mucilages (3).
Oleata.—Oleates (2).
Oxymellita.—Oxymels (2).
Pilulæ.—Pills (21).
Pulveres.—Powders (15).
Spiritus.—Spirits (18).
Succi.—Juices (7).
Suppositoria.—Suppositories (8).
Syrupi.—Syrups (17).
Tabellæ.—Tablets (1).
Tinctura.—Tinctures (74).
Trochisci.—Lozenges (12).
Unguenta.—Ointments (43).
Vapores—Inhalations (6).
Vina.—Wines (11).

Before proceeding to discuss the processes involved in the production of the above, it will be expedient and useful for purposes of reference, not only to enumerate, with a brief description of each, the crude substances to be dealt with (p. 94), but, for the instruction of students from whom a compulsory knowledge of Botany is no longer required, to devote a few pages, *firstly*, to the consideration of the nomenclature adopted in such descriptions, and, *secondly*, to the principal characteristics of crude vegetable material in general (p. 123).

N.B.—The more strictly galenical text recommences on page 131.

"**Nomenclature.**—The name of a plant is the name of its genus, followed by that of the species. The name of the genus answers to the surname (or family name); that of the species to the baptismal name of a person. Thus *Quercus* is the name of the oak genus ; *Quercus alba*, that of the White oak ; *Q. rubra*, that of the Red oak ; *Q. nigra*, that of the Black oak, &c. Botanical names being Latin or Latinized, the adjectival name of the species comes after that of the genus.

"**Names of Genera** are of one word, a substantive. The older ones are mostly classical Latin, or Greek adopted into Latin; such as *Quercus* for the Oak genus, *Fagus* for the Beech, *Corylus* the Hazel, and the like. But as more genera became known, botanists had new names to make or borrow. Many are named from some appearance or property of the flowers, leaves, or other parts of the plant. To take a few examples from the early pages of the 'Manual of the Botany of the Northern United States':—The genus *Hepatica* comes from the shape of the leaf, resembling that of the liver. *Myosurus* means mouse-tail. *Delphinium* is from the delphin, a dolphin, and alludes to the shape of the flower, which was thought to resemble the classical figures of the dolphin. *Xanthorrhiza* is from two Greek words meaning yellow-root, the common name of the plant. *Cimicifuga* is formed of two Latin words meaning to drive away bugs, *i.e.*, Bugbane, the Siberian species being used to keep away such vermin. *Sanguinaria*, the Bloodroot, is named from the blood-like colour of its juice. Other genera are dedicated to distinguished botanists or promoters of science, and bear their names : such as *Magnolia*, which commemorates the early French botanist, Magnol ; and *Jeffersonia*, named after President Jefferson, who sent the first exploring expedition over the Rocky Mountains. Others bear the name of the discoverer of the plant ; as *Sarracenia*, dedicated to Dr. Sarrazin, of Quebec, who was one of the first to send the common Pitcher-plant to the botanists of Europe ; and *Claytonia*, first made known by the early Virginian botanist Clayton.

"**Names of Species.**—The name of a species is also a single word, appended to that of the genus. It is commonly an adjective, and therefore agrees with the generic name in case, gender, etc. Sometimes it relates to the country the species inhabits ; as Claytonia *Virginica*, first made known from Virginia ; Sanguinaria *Canadensis*, from Canada, &c. More commonly it denotes some obvious or characteristic trait of the species; as, for example, in Sarracenia, our northern species is named *purpurea*, from the purple blossoms, while a more southern one is named *flava*, because its petals are yellow ; the species of Jeffersonia is called *diphylla*, meaning two-leaved, because its leaf is divided into two leaflets. Some species are named after the discoverer, or in compliment to a botanist who has made them known, as, Magnolia *Fraseri*, named after the botanist Fraser, one of the first to find this species ; and Sarracenia *Drummondii*, for a Pitcher-plant found by Mr. Drummond in Florida. Such personal specific names are, of course written with a capital initial letter. Occasionally some old substantive name is used for the species ; as Magnolia Umbrella, the Umbrella tree ; and Ranunculus *Flammula*. These are also written with a capital initial, and need not accord with the generic name in gender. Geographical specific names, such as *Canadensis*, *Carolinaria*, *Americana*, in the later usage are by some written without a capital initial, but the older usage is better, or at least more accordant with English orthography.

"**Varietal Names**, when any are required, are made on the plan of specific names, and follow these, with the prefix *var.* *Ranunculus Flammula*, var. *reptans*, the creeping variety ; *R. abortivus*, var. *micranthus* the small-flowered variety of the species.

"In recording the name of a plant, it is usual to append the name, or an

abbreviation of the name, of the botanist who first published it; and in a flora or other systematic work, this reference to the source of the name is completed by a further citation of the name of the book, the volume and page, where it was first published. So '*Ranunculus acris*, L.' means that this Buttercup was first so named and described by Linnæus; '*R. multifidus*, Pursh,' that this species was so named and published by Pursh. The suffix is no part of the name, but is an abbreviated reference, to be added or omitted as convenience or definiteness may require. The authority for a generic name is similarly recorded. Thus, '*Ranunculus*, L.' means that the genus was so named by Linnæus; '*Myosurus*, Dill.,' that the mouse-tail was established as a genus under this name by Dillenius; '*Caulophyllum*, Michx.,' that the Blue Cohosh was published under this name by Michaux. The full reference in the last-named instance would be 'Flora Boreali-Americana, first volume, 205th page,'—in the customary abbreviation, 'Michx., Fl. i. 205.'

"**Names of Orders** are given in the plural number, and are commonly formed by prolonging the name of a genus of the group taken as a representative of it. For example, the order of which the Buttercup or Crowfoot genus, *Ranunculus*, is the representative, takes from it the name of *Ranunculaceæ;* meaning *Plantæ Ranunculaceæ* when written out in full—that is, Ranunculaceous Plants. Some old descriptive names of orders are kept up, such as *Cruciferæ* for the order to which cress and mustard belong, from the cruciform appearance of their expanded corolla, and *Umbelliferæ* from the flowers being in umbels.

"**Names of Tribes**, also of sub-orders, sub-tribes, and the like, are plurals of the name of the typical genus, less prolonged, usually in *eæ*, *ineæ*, *ideæ*, &c. Thus the proper Buttercup tribe is *Ranunculeæ*, the Clematis tribe, *Clematideæ*. While the Rose family is *Rosaceæ*, the special Rose tribe is *Roseæ*.

"So a plant is named in two words, the generic and the specific names, to which may be added a third, that of the variety, upon occasion. The generic name is peculiar; obviously it must not be used twice over in botany. The specific name must not be used twice over in the same genus; but is free for any other genus. A *Quercus alba*, or White Oak, is no hindrance to *Betula alba*, or White Birch; and so of other names.

"**Characters and Descriptions.**—Plants are *characterised* by a terse statement, in botanical terms, of their peculiarities or distinguishing marks. The character of the order should include nothing which is common to the whole class it belongs to; that of the genus, nothing which is common to the order; that of the species, nothing which is shared with all other species of the genus; and so of other divisions.

"*Descriptions* may enter into complete details of the whole structure"—(Asa Gray's *Elements of Botany*).

[CHART I.

I. A CHART OF PHARMACOPŒIAL

THEIR *Pharmacopœial Preparations* AND OTHER

Substance.	Description.	Order.
Acacia, . .	Gum exuded from stem and branches of *Acacia Senegal* and other species.	Leguminosæ.
Aconitum, . .	Fresh leaves and flowering tops, and dried root of *Aconitum Napellus*.	Ranunculaceæ.
Alöe Barbadensis,.	Inspissated juice of the leaf of *Alöe vulgaris*.	Liliaceæ.
Alöe Socotrina, .	Inspissated juice of the leaf of *Alöe Perryi* and other species.	Liliaceæ.
Ammoniacum, .	Gum-resinous exudation from stem of *Dorema Ammoniacum*.	Umbelliferæ.
Amygdala Amara,	Fixed oil of the seed of *Prunus Amygdalus*, var. *amara*.	Rosaceæ.
Amygdala Dulcis,	Seed ("Jordan Almonds"), and the oil of the seed of *Prunus Amygdalus*, var. *dulcis*.	Rosaceæ.
Amylum, . .	Starch of *Triticum sativum* (wheat), *Zea Mays* (maize), *Oryza sativa* (rice).	Graminaceæ.
Anethi Fructus, .	Fruit of *Peucedanum graveolens*.	Umbelliferæ.
Anisi Oleum, .	Oil from the fruit of *Pimpinella Anisum*, *Illicium anisatum*, Star-anise.	Umbelliferæ. Magnoliaceæ.

[1] For assistance in studying the physical characters of these substances (in and a pocket lens magnifying from 10 to 15 diameters. The characteristic

N.B.—Under the division entitled "Preparations," observe that the "phar- it may enter, in ordinary type.

VEGETABLE SUBSTANCES.[1]

PREPARATIONS INTO WHICH THEY ENTER.

Region.	Preparations.
Kordofan, in East Africa.	Mist. Cretæ; Mist. Guaiaci; *Mucilago Acaciæ;* Pulv. Amygdalæ Co.; Pulv. Tragacanth Co. All Trochisci.
Germany or Britain.	Fresh leaves and flowering top (Britain) = *Extractum.* Root = *Linimentum, Tinctura,* and *Aconitina.*
Barbadoes and Dutch West Indian Islands.	*Alöin; Enema Alöes; Ext. Alöes Barb.; Pil. Alöes Barb.; Pil. Alöes et Ferri;* Pil. Cambogiæ Comp.; Pil. Colocynthidis Co.; Pil. Colocynthidis et Hyoscyami.
Socotra (shipped by way of Bombay and Zanzibar).	*Alöin; Decoct. Alöes Co.; Enema Alöes; Ext. Alöes Socotrinæ;* Ext. Coloc. Co.; *Pil. Alöes et Asafœtidæ; Pil. Alöes et Myrrhæ; Pil. Alöes Socot.;* Pil. Rhei Co.; *Tinct. Alöes;* Tinct. Benzoini Co.; *Vinum Alöes.*
Persia and the Punjaub.	*Emplastrum Ammoniaci c. Hydrargyro;* Emplast. Galbani; *Mistura Ammoniaci;* Pilula Scillæ Co.; Pil. Ipecac. c. Scillâ.
Mogadore.	*Oleum Amygdalæ;* Ol. Phosphoratum; Unguent. Cetacei; Ung. Simplex.
Malaga.	*Oleum Amygdalæ; Pulvis Amygdalæ Compositus; Mistura Amygdalæ.*
Cultivated in various parts of the world.	*Glycerinum Amyli; Mucilago Amyli;* Pulvis Tragacanth. Co.; Suppos. Acid Tannici c. Sapone; Suppos. Morphinæ c. Sapone.
England, Middle and Southern Europe.	*Aqua Anethi; Oleum Anethi.*
Distilled in Europe. Distilled in China.	*Ess. Anisi; Aqua Anisi, Oleum Anisi;* Tinct. Camph. Co.; Tinct. Opii Ammoniata.

the Materia Medica Museum), the student should be possesed of a sharp knife features of sections of roots, barks, &c., should be sketched into a note-book. macopœial preparations of the drug" are printed in italics, others into which

A CHART OF PHARMACOPŒIAL

Substance.	Description.	Order.
Anthemidis Flores,	Dried single and double flower-heads or capitula (*Anthemis nobilis*).	Compositæ.
Armoraciæ Radix,	Fresh root of *Cochlearia Armoracia.*	Cruciferæ.
Arnicæ Rhizoma,	Dried rhizomes and rootlets of *Arnica montana.*	Compositæ.
Asafœtida, . .	Gum-resin of *Ferula Narthex,* and probably other species.	Umbelliferæ.
Aurantii Flores, .	Flowers of *Citrus vulgaris* (bitter orange), and of *Citrus Aurantium* (sweet orange).	Aurantiaceæ.
Aurantii Cortex, .	Dried outer rind of fruit of *Citrus vulgaris.*	Aurantiaceæ.
Aurantii Fructus,	Ripe fruit of *Citrus vulgaris.*	Aurantiaceæ.
Balsamum Peruvianum,	Balsam from the trunk of *Myroxylon Pereiræ.*	Leguminosæ.
Balsamum Tolutanum,	Balsam from the trunk of *Myroxylon Toluifera.*	Leguminosæ.
Belæ Fructus, .	Dried half-ripe fruit of *Ægle Marmelos.*	Aurantiaceæ.
Belladonna, .	Leaves (with or without branches), fresh and dried, and root of *Atropa Belladonna.*	Atropaceæ.
Benzoinum, .	Balsamic resin of *Styrax Benzoin* and other species.	Styraceæ.
Buchu Folia, .	Dried leaves of *Barosma betulina, B. crenulata, B. serratifolia.*	Rutaceæ.

VEGETABLE SUBSTANCES—*continued.*

Region.	Preparations.
Britain (cultivated).	*Extractum, Infusum, Oleum Anthemidis.*
Britain.	*Spiritus Armoraciæ Compositus.*
Mountainous parts of Middle and Southern Europe.	*Tinctura Arnicæ.*
Afghanistan and Punjaub.	*Enema Asafœtidæ; Pil. Alöes et Asafœtidæ; Pil. Asafœtidæ Co.;* Spiritus Ammoniæ Fœtidus; *Tinctura Asafœtidæ.*
South of Europe.	*Aqua Aurantii Floris* (imported generally).
South of Europe.	*Inf. Aurantii; Inf. Aurantii Comp.*; Inf. Gentian. Comp.; *Tinct. Aurantii;* Tinct. Gentian. Comp.; Tinct. Cinchon. Comp.; Spirit. Armoraciæ Comp.
South of Europe.	*Tinct. Aurantii Recentis* and *Vinum Aurant.* (both from fresh peel).
Salvador, in Central America.	...
New Granada.	*Syrupus Tolutanus;* Tinct. Benzoini Co.; *Tinct. Tolutana;* Pil. Phosphori.
Malabar and Coromandel.	*Extractum Belæ Liquidum.*
(Leaves) Britain; (Root) Britain, Germany.	Fresh leaves and branches = *Extract. Belladonnæ; Succus Belladonnæ;* Dried leaves = *Tinct. Belladonnæ.* Root = *Linimentum Belladonnæ; Atropina; Extract. Belladonnæ Alcoholicum.*
Siam and Sumatra.	*Acidum Benzoicum; Adeps Benzoatus* (and ointments containing it); *Tinct. Benzoini Co.;* Ung. Cetacei.
Cape of Good Hope.	*Infusum Buchu, Tinctura Buchu.*

A CHART OF PHARMACOPŒIAL

Substance.	Description.	Order.
Caffeina, . .	Alkaloid from dried leaves of tea or seeds of coffee, (1) *Camellia thea*, (2) *Coffea arabica.*	Ternstrœmiaceæ (1). Cinchonaceæ (2).
Cajuputi Oleum, .	Oil distilled from the leaves of *Melaleuca minor.*	Myrtaceæ.
Calumbæ Radix, .	Dried sliced root of *Jateorhiza Calumba.*	Menispermaceæ.
Cambogia, . .	Gum-resin of *Garcinia Hanburii.*	Guttiferæ.
Camphora, . .	A stearoptene obtained from the wood of *Cinnamomum Camphora.*	Lauraceæ.
Canellæ Albæ Cortex,	Dried bark (deprived of its corky layer) of *Canella alba.*	Canellaceæ.
Cannabis Indica, .	Dried flowering or fruiting tops of female plants of *Cannabis sativa.*	Cannabinaceæ.
Capsici Fructus, .	Dried ripe fruit of *Capsicum fastigiatum.*	Solanaceæ.
Cardamomum, .	Seeds of the dried capsules of *Elettaria Cardamomum.*	Zingiberaceæ.
Carui Fructus .	Dried fruit of *Carum Carui.*	Umbelliferæ.
Caryophyllum, .	Dried flower-buds of *Eugenia caryophyllata.*	Myrtaceæ.
Cascara Sagrada,	Dried bark of *Rhamnus Purshianus.*	Rhamnaceæ.
Cascarillæ Cortex,	Dried bark of *Croton Eluteria.*	Euphorbiaceæ.

VEGETABLE SUBSTANCES—*continued.*

Region.	Preparations.
China, Japan, and India. Cultivated throughout the Tropics, native of Abyssinia.	*Caffeina; Caffeinæ Citras.*
Imported from Batavia and Singapore.	*Spiritus Cajuputi,* Lin. Crotonis.
Eastern Africa, between Ibo and Zambesi.	*Extractum, Infusum,* and *Tinct. Calumbæ;* Mist. Ferri Aromat.
Siam.	*Pilula Cambogiæ Composita.*
China and Japan (purified here by sublimation).	*Aqua Camph.; Linimentum Camph.; Lin. Camph. Co.; Spiritus Camph.; Tinct. Camph. Co.;* Ung. Hydrarg. Co.; and all the liniments except Ammoniæ, Calcis, Crotonis, Potassii Iodidi c. Sapone.
West Indies.	Vinum Rhei.
India.	*Extractum Cannabis Ind.; Tinctura Cannab. Ind.*
Zanzibar.	*Tinctura Capsici.*
Malabar.	*Tinct. Cardam. Co.;* Ext. Coloc. Co.; Pulv. Cinnam. Co.; Pulv. Cretæ Arom.; Tinct. Gentian. Co.; Tinct. Rhei; Vinum Alöes.
From England and Germany.	*Aqua* and *Oleum Carui;* Confectio Opii; Conf. Piperis; Pulvis Opii Compositus; Tinct. Cardam. Co.; Tinct. Sennæ.
Penang, Bencoolen, and Amboyna.	*Infusum* and *Oleum Caryophylli;* Inf. Aurant Co.; Mist. Ferri Arom.; Vinum Opii.
Pacific coast of North America.	*Ext. Cascaræ Sagradæ; Ext. Cascaræ Sagrad. Liquid.*
Bahama Islands.	*Infusum* and *Tinctura Cascarillæ.*

A CHART OF PHARMACOPŒIAL

Substance.	Description.	Order.
Cassiæ Pulpa, .	Pulp from pods of *Cassia fistula*.	Leguminosæ.
Catechu, . .	An aqueous extract of the leaves and young shoots of *Uncaria Gambier*.	Cinchonaceæ.
Cerevisiæ Fermentum,	Beer-yeast of *Saccharomyces cerevisiæ*.	Fungi.
Cetraria, . .	The entire lichen dried of *Cetraria islandica*.	Lichenes.
Chirata, . .	Entire plant of *Ophelia Chirata*.	Gentianaceæ.
Chrysarobinum, .	Medullary matter of stem and branches of *Andira araroba*, as purified by solvents.	Leguminosæ.
Cimicifugæ Rhizoma,	Dried rhizome and rootlets of *Cimicifuga racemosa*.	Ranunculaceæ.
Cinchonæ Cortex, .	Dried bark of *Cinchona Calisaya*, *C. succirubra*, *C. officinalis*, *C. lancifolia*, with others.	Cinchonaceæ.
Cinchonæ Rubræ Cortex,	Dried bark of stem and branches of "cultivated" plants of *Cinchona succirubra*.	Cinchonaceæ.
Cinnamomi Cortex	The dried inner bark of shoots from the truncated stocks of *Cinnamomum zeylanicum*.	Lauraceæ.
Coca, . . .	Dried leaves of *Erythroxylon Coca*.	Erythroxylaceæ.
Colchicum, . .	Fresh and dried corm and dried ripe seeds of *Colchicum autumnale*.	Melanthaceæ.
Colocynthidis Pulpa,	Dried peeled fruit freed from seeds of *Citrullus Colocynthis*.	Cucurbitaceæ.
Conium, . .	Fresh leaves and young branches and dried fruit of *Conium maculatum*.	Umbelliferæ.

VEGETABLE SUBSTANCES—*continued.*

Region.	Preparations.
East and West Iudies.	Confectio Sennæ.
Singapore and other places in the Eastern Archipelago.	*Infusum Catechu, Pulvis Catechu Comp., Tinctura Catechu, Trochisci Catechu.*
...	*Cataplasma Fermenti.*
North of Europe.	*Decoctum Cetrariæ.*
Northern India.	*Infusum* and *Tinctura Chiratæ.*
India.	*Ung. Chrysarobini.*
North America.	*Ext. Cimicifugæ Liquid.; Tinct. Cimicifugæ.*
...	Cinchonidinæ Sulphas; Cinchoninæ Sulphas Quininæ Hydrochloras; Quininæ Sulphas.
Native of South America, cultivated in Jamaica, Ceylon, and India.	*Decoct. Cinchonæ; Ext. Cinchon. Liquid;* Inf. *Cinchon. Acid; Tinct. Cinchonæ; Tinct. Cinchon. Comp.;* Mist. Ferri Ar.
Ceylon.	*Aqua, Oleum, Pulvis Co.,* and *Tinct. Cinnamomi, Infusum, Pulvis Co.,* and Tinct. Catechu; Decoct. Hæmatoxyli, Pulv. Cretæ Arom.; Pulv. Kino Co.; Tinct. Cardam. Co.; Tinct. Lavand Co.; Vinum Opii.
Peru.	*Ext. Cocæ Liquid; Cocainæ Hydrochloras; Lamellæ Cocainæ.*
Indigenous.	Corm = *Extractum, Extractum Aceticum,* and *Vinum Colchici;* Seeds = *Tinctura Colchici Seminum.*
Smyrna, Trieste, France, and Spain.	*Extractum Coloc. Co.; Pil. Coloc. Co.; Pil. Coloc. et Hyoscyam.*
Britain (wild plants).	*Cataplasma* (made with "juice"), *Extractum,* and *Succus Conii* (from the fresh leaves); *Tinctura Conii* (from the fruit).

A Chart of Pharmacopœial

Substance.	Description.	Order.
Copaiba, . .	Oleo-resin of *Copaifera Langsdorffii*, and other species.	Leguminosæ.
Coriandri Fructus,	Dried ripe fruit of *Coriandrum sativum*.	Umbelliferæ.
Crocus, . .	The dried stigmas and top of style of *Crocus sativus*.	Iridaceæ.
Crotonis Oleum, .	Oil from the seeds of *Croton Tiglium*.	Euphorbiaceæ.
Cubeba, . .	Dried unripe fruit of *Piper Cubeba*.	Piperaceæ.
Cuprea, . .	Bark of *Remijia* sp. (*q.v.*).	
Cuspariæ Cortex, .	Dried bark of *Galipea Cusparia*.	Rutaceæ.
Cusso, . . .	Dried panicles of *Hagenia abyssinica*.	Rosaceæ.
Digitalis Folia, .	Dried leaf of *Digitalis purpurea*.	Scrophulariaceæ.
Ecballii Fructus, .	Nearly ripe fruit of *Ecballium Elaterium*.	Cucurbitaceæ.
Elemi, . .	A concrete resinous exudation, referred to *Canarium commune*.	Amyridaceæ.
Ergota, . .	The sclerotium of *Claviceps purpurea*, produced between the paleæ of the common Rye *Secale cereale*.	Graminaceæ.
Eucalypti Oleum,	Distilled oil from the leaves of *Eucalyptus globulus* and *Eucalyptus amygdalina*.	Myrtaceæ.
Farina Tritici, .	The grain of wheat ground and sifted, of *Triticum sativum*.	Graminaceæ.
Ficus, . . .	Dried fruit of *Ficus Carica*.	Moraceæ.

VEGETABLE SUBSTANCES—*continued.*

Region.	Preparations.
Valley of the Amazon.	*Oleum Copaibæ.*
Britain.	*Oleum Coriandri;* Conf. Sennæ; Syrupus and Tinct. Rhei; Syrupus and Tinct. Sennæ.
Spain, France, and Italy.	*Tinctura Croci;* Decoct. Alöes Co.; Pil. Alöes et Myrrh; Pulv. Cretæ Aromat.; Tinct. Cinchon. Co.; Tinct. Opii Ammon.; Tinct. Rhei.
Hindostan, Ceylon, and Indian Archipelago.	*Linimentum Crotonis.*
Java.	*Oleum Cubebæ; Tinctura Cubebæ; Oleo-Resina Cubebæ.*
Tropical South America.	*Infusum Cuspariæ.*
Abyssinia.	*Infusum Cusso.*
Indigenous.	*Infusum* and *Tinctura Digitalis.*
Britain.	*Elaterium, Elaterinum, Pulvis Elaterini Compositus.*
Manilla.	*Unguentum Elemi.*
...	*Extractum Ergotæ Liquidum, Infusum Ergotæ, Tinctura Ergotæ; (Ergotinum, Inject. Ergotin. Hypoderm.).*
Australia.	*Unguentum Eucalypti.*
Britain.	Cataplasma Fermenti; *vide* Amylum.
Smyrna.	Confectio Sennæ.

A CHART OF PHARMACOPŒIAL

Substance.	Description.	Order.
Filix-Mas, . .	Dried rhizome of *Aspidium Filix-mas*.	Filices.
Fœniculi Fructus,	Dried fruit of *Fœniculum capillaceum*.	Umbelliferæ.
Galbanum, . .	Gum-resin of *Ferula galbaniflua*, *Ferula rubricaulis*, and probably other species.	Umbelliferæ.
Galla, . .	Excrescences caused by the punctures and deposited ova of *Cynips Gallæ tinctoriæ* found on *Quercus lusitanica*, var. *infectoria*.	Cupuliferæ.
Gelsemium, . .	Dried rhizome and rootlets of *Gelsemium nitidum*.	Loganiaceæ.
Gentianæ Radix, .	Dried root of *Gentiana lutea*.	Gentianaceæ.
Glycyrrhizæ Radix,	Root and underground stem, fresh and dried, of *Glycyrrhiza glabra*.	Leguminosæ.
Gossypium, . .	Hairs of the seed of *Gossypium barbadense*, and other species.	Malvaceæ.
Granati Radicis Cortex,	Dried bark of the root of *Punica Granatum*.	Granateæ.
Guaiaci Lignum,	Heart-wood in chips of *Guaiacum officinale*, or *Guaiacum sanctum*.	Zygophyllaceæ.
Guaiaci Resina, .	Resin.	...
Gutta Percha, .	Concrete juice of *Dichopsis Gutta*, and several other trees.	Sapotaceæ.
Hæmatoxyli Lignum,	Sliced heart-wood of *Hæmatoxylum campechianum*.	Leguminosæ.
Hemidesmi Radix,	Dried root of *Hemidesmus indicus*.	Asclepiadaceæ.

VEGETABLE SUBSTANCES—*continued.*

Region.	Preparations.
Indigenous.	*Extractum Filicis Liquidum.*
Malta.	*Aqua Fœniculi;* Pulv. Glycyrrhizæ Co.
India and the Levant.	*Emplast. Galbani;* Pil. Asafœtidæ Co.
Asia Minor.	*Acidum Gallicum* and *Tannicum; Tinct. Gallæ, Ung. Gallæ,* and *Ung. Gallæ c. Opio.*
America.	*Extract. Gelsemii Alcoholicum; Tinct. Gelsemii.*
Central and Southern Europe (mountains).	*Extractum, Infusum Co.,* and *Tinct. Gentianæ Co.*
England.	*Extract., Ext. Liquid,* and *Pulv. Glycyrrh. Co.;* Conf. Tereb., Dec. Sarsæ Co.; Inf. Lini.; Pil. Hydr.; Pil. Ferri Iodid.
From warm and tropical regions.	Pyroxyliu.
South of Europe.	*Decoctum Granati Radicis.*
St. Domingo and Jamaica.	Decoct. Sarsæ Co.
...	*Mist. Guaiaci;* Pil. Hydrarg. Subchlor. Co.; *Tinct. Guaiaci Ammon.*
...	*Liquor Gutta Percha.*
Campeachy, Honduras, and Jamaica.	*Decoctum* and *Extractum Hæmatoxyli.*
India.	*Syrupus Hemidesmi.*

A CHART OF PHARMACOPŒIAL

Substance.	Description.	Order.
Hordeum Decorticatum,	Husked seeds of *Hordeum distichon.*	Graminaceæ.
Hyoscyami Folia,	Dried second years' leaves with or without branches of *Hyoscyamus niger.*	Atropaceæ.
Ipecacuanha, .	Dried root of *Cephaëlis Ipecacuanha.*	Cinchonaceæ.
Jaborandi, . .	Dried leaflets of *Pilocarpus pennatifolius.*	Rutaceæ.
Jalapa, . .	Dried tubercules of *Ipomœa Purga.*	Convolvulaceæ.
Juniperus, . .	Oil from the unripe fruit of *Juniperus communis.*	Coniferæ.
Kamala, . .	Minute glands and hairs obtained from the surface of the fruits, *Mallotus philippinensis.*	Euphorbiaceæ.
Kino, . . .	Inspissated juice from the trunk of *Pterocarpus Marsupium.*	Leguminosæ.
Krameriæ Radix,	Dried root of *Krameria triandra, Krameria Ixina*, var. *granatensis.*	Polygalaceæ.
Lactuca, . .	Flowering herb of *Lactuca virosa.*	Compositæ.
Laricis Cortex, .	Dried inner bark of *Pinus Larix.*	Coniferæ.
Laurocerasi Folia,	Fresh leaves of *Prunus laurocerasus.*	Rosaceæ.
Lavandulæ Oleum,	From flowers of *Lavandula vera.*	Labiatæ.
Limonis, . .	Peel and Juice of fruit of *Citrus Limonum.*	Aurantiaceæ.

VEGETABLE SUBSTANCES—*continued.*

Region.	Preparations.
Britain.	*Decoctum Hordei.*
Britain.	*Extractum*, *Succus* (both from fresh tops), and *Tinctura Hyoscyami.*
Brazil.	*Pil. Ipecac. c. Scillâ; Pulv. Ipecac. Co.; Trochisci Ipecac.; Trochisci Morphinæ et Ipecac.; Vinum Ipecac.;* Pil. Conii Co.
Pernambuco.	*Extract.*, *Infusum*, and *Tinct. Jaborandi; Pilocarpinæ nitras.*
Mexico and Jamaica.	*Extractum*, *Pulv. Co.*, *Resina*, and *Tinctura Jalapæ;* Pulvis Scammonii Compositus; Pil. Scammonii Comp.
North of Europe, indigenous.	*Oleum*, *Spiritus.*
India.	...
Malabar.	*Pulvis Compositus*, *Tinct. Kino;* Pulv. Catechu Co.
Peru, Venezuela.	*Extractum*, *Infusum*, *Tinctura Krameriæ;* Pulv. Catechu Co.
Indigenous.	*Extractum Lactucæ.*
Indigenous.	*Tinct. Laricis.*
Britain.	*Aqua Laurocerasi.*
South of Europe.	*Spiritus* and *Tinctura Composita;* Lin. Camph. Co.
South of Europe.	Cortex = *Oleum*, *Syrupus*, *Tinctura Limonis;* Inf. Aurant. Co.; Inf. Gentian. Co.; Succus = *Syrupus Limonis.*

A CHART OF PHARMACOPŒIAL

Substance.	Description.	Order.
Linum, . .	Dried ripe seeds, entire and reduced to powder of *Linum usitatissimum*.	Linaceæ.
Lobelia, . .	Dried flowering herb of *Lobelia inflata*.	Lobeliaceæ.
Lupulus, . .	Dried strobiles of *Humulus Lupulus*.	Cannabinaceæ.
Manna, . .	Concrete Saccharine exudation from the stem of *Fraxinus Ornus*.	Oleaceæ.
Mastiche, . .	Concrete resinous exudation from the stem and branches of *Pistacia Lentiscus*.	Anacardiaceæ.
Maticæ Folia, .	Dried leaves of *Piper angustifolium*.	Piperaceæ.
Mentha piperita, .	Oil distilled in Britain from *Mentha piperita*.	Labiatæ.
Mentha viridis .	Oil distilled in Britain from *Mentha viridis*.	Labiatæ.
Menthol, . .	Stearoptene of oil of *Mentha arvensis*, vars. *piperascens et glabrata* and *Mentha piperita*.	Labiatæ.
Mezerei Cortex, .	Dried bark of *Daphne Mezereum* and *D. Laureola*.	Thymelaceæ.
Mica Panis, .	Crumb of bread of wheat-flour of *Triticum sativum*.	Graminaceæ.
Mori Succus, .	Juice of ripe fruit of *Morus nigra*.	Moraceæ.
Myristica, . .	Dried seed divested of its coats of *Myristica fragrans*.	Myristicaceæ.
Myrrha, . .	Gum-resin (from the stem) of *Balsamodendron Myrrha*.	Amyridaceæ.

VEGETABLE SUBSTANCES—*continued.*

Region.	Preparations.
Britain.	*Farina Lini, Infusum Lini, Oleum Lini;* Cataplasmata except Fermenti.
North America.	*Tinctura Lobeliæ, Tinct. Lobeliæ Ætherea.*
England.	*Extractum, Infusum, Tinctura Lupuli, Lupulinum.*
Calabria and Sicily.	...
Island of Scio.	...
Peru.	*Infusum Maticæ.*
Britain.	*Aqua, Essentia,* and *Spiritus Menthæ Piperitæ;* Pil. Rhei Co.; Tinct. Chloroformi et Morphinæ.
Britain.	*Aqua Menthæ Viridis.*
Britain, China and Japan, United States.	...
Indigenous.	*Extractum Mezerei Æthereum;* Decoctum Sarsæ Compositum.
Indigenous.	Cataplasma Carbonis.
Cultivated in Britain.	*Syrupus Mori.*
Banda Islands of the Malayan Archipelago.	*Oleum* and *Oleum Myristicæ Expressum;* Pulv. Catechu Co.; Pulv. Cretæ Aromat.; Sp. Armoraciæ Co.; Tinct. Lavand. Co.
Arabia Felix and Abyssinia.	*Tinct. Myrrh.; Pil. Aloës et Myrrh.;* Decoct. Aloës Co.; Mist. Ferri Co.; Pil. Asafœtidæ Co.; Pil. Rhei Co.

A CHART OF PHARMACOPŒIAL

Substance.	Description.	Order.
Nectandræ Cortex,	Dried bark of *Nectandra Rodiæi.*	Lauraceæ.
Nux Vomica, .	Seeds of *Strychnos Nux-vomica.*	Loganiaceæ.
Olivæ Oleum, .	Oil from the ripe fruit of *Olea europæa.*	Oleaceæ.
Opium, . .	Inspissated juice from unripe capsules of *Papaver somniferum.*	Papaveraceæ.
Papaveris Capsulæ,	Nearly ripe dried capsules of white poppy of *Papaver somniferum.*	Papaveraceæ.
Pareiræ Radix, .	Dried root of *Chondrodendron tomentosum.*	Menispermaceæ.
Physostigmatis Semen,	Dried seed of *Physostigma venenosum.*	Leguminosæ.
Pimenta, . .	Dried unripe fruits of *Pimenta officinalis.*	Myrtaceæ.
Piper Nigrum, .	Dried unripe fruit of *Piper nigrum.*	Piperaceæ.
Pix Burgundica, .	Resinous exudation from the stem of *Pinus Picea.*	Coniferæ.
Pix Liquida, .	Bituminous liquid obtained from the wood of *Pinus sylvestris*, and other species (by destructive distillation).	Coniferæ.
Podophylli Rhizoma,	Dried rhizome and rootlets of *Podophyllum peltatum.*	Berberideæ.
Prunum, . .	Dried drupe (the plum) of *Prunus domestica.*	Rosaceæ.
Pterocarpi Lignum,	Heart-wood of *Pterocarpus santalinus.*	Leguminosæ.
Pyrethri Radix, .	Dried root of *Anacyclus Pyrethrum.*	Compositæ.

VEGETABLE SUBSTANCES—*continued.*

Region.	Preparations.
British Guiana.	*Beberinæ Sulphas.*
East Indies.	*Extractum* and *Tinctura Nucis Vomicæ; Strychnine.*
South of Europe.	Charta Epispastica; Emplastra; Enema Mag. Sulph.; Lin. Ammon., Calcis, Camphoræ; Unguenta.
Asia Minor (Smyrna).	Preparations (numerous), (see *Index*).
Britain.	*Decoctum, Extractum, Syrupus Papaveris.*
Brazil.	*Decoctum, Extractum, Extractum Pareiræ Liquidum.*
Western Africa.	*Extractum Physostigmatis; Physostigmina (Escrina); Lamellæ Physostigminæ.*
West Indies.	*Aqua, Oleum Pimentæ.*
East Indies.	Confectio Opii; *Confectio Piperis;* Pulv. Opii Co.
Germany.	Emplastrum Ferri; *Emplastrum Picis.*
Scotland, Denmark, and Norway.	*Unguentum Picis Liquidæ.*
North America.	*Resina Podophylli, Tinctura Pod.*
South of France.	Confectio Sennæ.
Ceylon.	Tinctura Lavandulæ Composita.
Levant.	*Tinctura Pyrethri.*

A CHART OF PHARMACOPŒIAL

Substance.	Description.	Order.
Quassiæ Lignum,	Wood of *Picræna excelsa.*	Simarubaceæ.
Quercus Cortex, .	Dried bark of young trees of *Quercus Robur.*	Cupuliferæ.
Remijia, . .	Generic name of trees yielding "Cuprea" Bark, a source of cinchona alkaloids.	Cinchonaceæ.
Resina, . .	The residue left after the distillation of the oil of turpentine from the crude oleoresin of various species of *Pinus.*	Coniferæ.
Rhamni Frangulæ Cortex,	Dried bark of *Rhamnus Frangula*, at least a year old.	Rhamnaceæ.
Rhamnus Purshianus (*see* Cascara Sagrada).	...	...
Rhei Radix, .	Dried root (deprived of the bark) of *Rheum palmatum* and *Rheum officinale*, and probably other species.	Polygonaceæ.
Rhœados Petala, .	Fresh petals of *Papaver rhœas.*	Papaveraceæ.
Ricini Oleum, .	Oil expressed from the seeds of *Ricinus communis.*	Euphorbiaceæ.
Rosæ Caninæ Fructus,	Ripe fruit of *Rosa canina*, and other indigenous allied species.	Rosaceæ.
Rosæ Centifoliæ Petala,	Fresh fully expanded petals of *Rosa centifolia.*	Rosaceæ.
Rosæ Gallicæ Petala,	Fresh and dried unexpanded petals of *Rosa gallica.*	Rosaceæ.
Rosmarini Oleum,	Oil distilled from the flowering tops of *Rosmarinus officinalis.*	Labiatæ.
Rutæ Oleum, .	Oil distilled from fresh herb of *Ruta graveolens.*	Rutaceæ.

VEGETABLE SUBSTANCES—*continued.*

Region.	Preparations.
Jamaica.	*Extractum*, *Infusum*, and *Tinctura Quassiæ.*
Britain.	*Decoctum Quercus.*
U.S., Colombia.	...
America.	Charta Epispastica, *Emplastrum* and *Unguentum Resinæ*, Ung. Terebinth., several Emplastra.
Europe.	*Ext. Rhamni Frangulæ*, *Ext. Rhamni Frangulæ Liquid.*
...	...
Collected and prepared in China and Thibet.	*Extractum Rhei*, *Infusum Rhei*; *Pilula Rhei Co.*, *Pulvis Rhei Co.*, *Syrupus Rhei*, *Tinctura Rhei*, and *Vinum Rhei.*
Indigenous.	*Syrupus Rhœados.*
India.	Collodium Flexile, Lin. Sinapis Comp., Pil. Hydrarg, Subchlor. Co.
Indigenous.	*Confectio Rosæ Caninæ.*
Britain.	*Aqua Rosæ.*
Britain.	*Confectio* (fresh); *Syrupus Rosæ Gallicæ*, *Infusum Rosæ Acidum* (dried).
South of Europe, Asia Minor, cultivated in England.	*Spiritus Rosmarini*; Lin. Saponis and Tinct. Lavand. Comp.
South of Europe.	...

A CHART OF PHARMACOPŒIAL

Substance.	Description.	Order.
Sabadilla, . .	Dried ripe seeds (freed from their pericarps) of *Schœnocaulon officinale.*	Melanthaceæ.
Sabinæ Cacumina,	Fresh and dried tops of *Juniperus Sabina.*	Coniferæ.
Saccharum, . .	Sugar from the stem of *Saccharum officinarum.*	Graminaceæ.
,,	Sugar from the root of *Beta vulgaris.*	Chenopodiaceæ.
Salicinum, . .	Crystalline glucoside obtained from the bark of *Salix alba*, and other species of Salix and various species of *Populus.*	Salicaceæ.
Sambuci Flores, .	Fresh flowers of *Sambucus nigra.*	Caprifoliaceæ.
Santali Oleum, .	Volatile oil distilled from the wood of *Santalum album.*	Santalaceæ.
Santonica, . .	Dried unexpanded flower-heads or capitula of *Artemisia maritima*, var. *Stechmanniana.*	Compositæ.
Sarsæ Radix, .	Dried root of *Smilax officinalis.*	Smilaceæ.
Sassafras Radix, .	Dried root of *Sassafras officinale.*	Lauraceæ.
Scammoniæ Resina,	From dried root of *Convolvulus scammonia.*	Convolvulaceæ.
Scammonium, .	Gum resin obtained from living root of *Convolvulus Scammonia.*	Convolvulaceæ.
Scilla, .	Sliced and dried bulb of *Urginea Scilla.*	Liliaceæ.
Scoparii Cacumina .	Fresh and dried tops of *Cytisus scoparius.*	Leguminosæ.

VEGETABLE SUBSTANCES—*continued.*

Region.	Preparations.
Mexico.	*Veratrina* (and *Ung.*).
Britain.	*Oleum*, *Tinctura*, and *Unguentum Sabinæ.*
West Indies.	All Syrups and Lozenges.
Europe.	
Temperate regions of the Northern Hemisphere.	..
Indigenous.	*Aqua Sambuci.*
India.	...
Russia.	*Santoninum* (Troch. Sant.).
Native of Central America, imported from Jamaica.	*Decoctum Sarsæ, Decoct. Sarsæ Co. Extractum Sarsæ Liquidum.*
North America.	Decoctum Sarsæ Co.
Syria and Asia Minor.	*Pil. Scam. Co.; Pulv. Scam. Co.; Conf. Scam.;* Ext. Col. Co.; Pil. Col. Co.; Pil. Con. et Hyoscyam.
Asia Minor.	*Mist. Scam.; Resina Scam.* (the latter also from dried root).
Mediterranean Coasts.	*Acetum, Oxymel, Pilula Scillæ Co.; Syrupus, Tinctura Scillæ; Pil. Ipecac. c. Scillâ.*
Indigenous.	*Decoct. Scoparii* (from dried); *Succus Scoparii* (from fresh).

A Chart of Pharmacopœial

Substance.	Description.	Order.
Senegæ Radix, .	Dried root of *Polygala Senega.*	Polygalaceæ.
Senna Alexandrina,	Dried leaflets of *Cassia acutifolia.*	Leguminosæ.
Senna Indica, .	Tinnivelly senna, dried leaflets of *Cassia angustifolia.*	Leguminosæ.
Serpentariæ Rhizoma,	Dried rhizome and rootlets of *Aristolochia Serpentaria* or *Aristolochia reticulata.*	Aristolochiaceæ.
Sinapis, . .	Mixed seeds of both *Brassica alba* and *nigra.*	Cruciferæ.
Staphisagriæ Semina,	Dried ripe seeds of *Delphinium Staphisagria.*	Ranunculaceæ.
Stramonii Semina,	Dried ripe seeds of *Datura Stramonium.*	Atropaceæ.
Styrax præparatus,	Balsam from the inner bark, purified, of *Liquidambar orientalis.*	Liquidambaraceæ.
Sumbul Radix, .	Dried root of *Ferula Sumbul.*	Umbelliferæ.
Tabaci Folia, .	Dried leaves of *Nicotiana Tabacum.*	Atropaceæ.
Tamarindus, .	Pulp of the fruit of *Tamarindus indica.*	Leguminosæ.
Taraxaci Radix, .	Fresh and dried roots of *Taraxacum officinale.*	Compositæ.
Terebinthina Canadensis, . .	Turpentina (Canada Balsam) of *Pinus balsamea.*	Coniferæ.
Theobromatis Oleum	Concrete oil of *Theobroma Cacao.*	Sterculiaceæ.
Theriaca, . .	Uncrystallisable residue of the refining of sugar of *Saccharum officinarum.*	Graminaceæ.
Thus Americanum,	Concrete turpentine of *Pinus Tæda* and of *P. australis.*	Coniferæ.

VEGETABLE SUBSTANCES—*continued.*

Region.	Preparations.
North America.	*Infusum* and *Tinctura Senegæ.*
Alexandria.	*Confectio, Infusum, Mistura Co., Syrupus,* and *Tinctura Sennæ;* Pulvis Glycyrrhizæ Compositus.
Southern India.	May be used in the place of Alexandrian Senna.
Southern parts of North America.	*Infusum* and *Tinctura Serpentariæ;* Tinct. Cinchon. Co.
Indigenous.	*Cataplasma, Charta,* and *Oleum Sinapis.*
...	*Unguentum Staphisagriæ.*
Britain.	*Extractum* and *Tinctura Stramonii.*
S.W. of Asia Minor and Cyprus.	Tinctura Benzoini Composita.
Russia and India.	*Tinctura Sumbul.*
America.	
West Indies.	Confectio Sennæ.
Britain.	*Decoctum* and *Extractum Liquidum* (dried), *Succus* and *Extractum Taraxaci* (fresh).
Canada.	Charta Epispastica; Collodium Flexile.
America.	Suppositoria (*q.v.*).
West Indies and elsewhere.	Various pill-masses and Tinct. Chloroformi et Morphina.
Southern States of North America.	Emplastrum Picis.

A CHART OF PHARMACOPŒIAL

Substance.	Description.	Order.
Thymol, . .	Stearoptene of the oils of either *Thymus vulgaris*, *Monada punctata*.	Labiatæ.
	Carum Ajowan.	Umbelliferæ.
Tragacantha, .	Gummy exudation from the stem of *Astragalus gummifer*.	Leguminosæ.
Uvæ Ursi Folia, .	Dried leaves of *Arctostaphylos Uva-ursi*.	Ericaceæ.
Uvæ, . . .	Ripe fruit of *Vitis vinifera* (Raisins).	Vitaceæ.
Valerianæ Rhizoma,	Dried rhizome and rootlets of *Valeriana officinalis*.	Valerianaceæ.
Veratrina, . .	The alkaloid from *Cevadilla* (or *Sabadilla*, *q.v.*).	Melanthaceæ.
Veratri Viridis Rhizoma, .	Dried rhizome and rootlets of *Veratrum viride*.	Melanthaceæ.
Zingiber, . .	Scraped and dried rhizome of *Zingiber officinale*.	Zingiberaceæ.

VEGETABLE SUBSTANCES—*continued.*

Region.	Preparations.
Largely produced in France.	...
...	...
Asia Minor.	*Mucilago, Glycerinum, Pulv. Tragac. Co.;* Conf. Opii; Conf. Sulphuris; Pulv. Opii Co.
Indigenous.	*Infusum Uvæ Ursi.*
Spain.	Tinct. Cardam. Co.; Tinct Sennæ.
Britain.	*Infusum, Tinctura, Tinctura Valerianæ Ammoniata.*
Mexico.	*Unguentum Veratrinæ.*
United States and Canada.	*Tinctura Veratri Viridis.*
West Indies and India.	*Syrupus, Tinctura, Tinctura Zingiberis Fortior.* Also used in some powders and numerous other preparations.

[CHART II.

II. CHART OF PHARMACOPŒIAL

The Pharmacopœial Animal Substances and

Substance.	Description.	Order.
Adeps, . .	Internal fat of the abdomen of *Sus scrofa.*	Pachydermata.
Cantharis, . .	The dried beetle, *Cantharis vesicatoria.*	Coleoptera.
Cera Flava, .	Prepared from honeycomb of *Apis mellifica.*	Hymenoptera.
Cetaceum, . .	A concrete fatty substance, mixed with oil obtained from the head of the sperm-whale, *Physeter macrocephalus.*	Cetacea.
Coccus, . .	Dried female insect. *Coccus cacti.*	Hemiptera.
Fel Bovinum Purificatum,	The purified gall of *Bos Taurus.*	Ruminantia.
Hirudo, . .	Leech, *Sanguisuga medicinalis* (speckled), *officinalis* (green).	...
Lac, . . .	Fresh milk, *Bos Taurus.*	Ruminantia.
Mel, . . .	Saccharine secretion in honeycomb, *Apis mellifica.*	Hymenoptera.
Morrhuæ Oleum, .	Oil of fresh liver of the cod, *Gadus Morrhua.*	...
Moschus, . .	Dried secretion from the preputial follicles of *Moschus moschiferus.*	Ruminantia.
Ovi Vitellus, .	Yolk of *Gallus Bankiva*, var. *domesticus.*	...
Saccharum Lactis,	Whey of milk, evaporated.	...

ANIMAL SUBSTANCES.

THEIR PHARMACOPŒIAL PREPARATIONS.

Region.	Preparations.
...	*Adeps Benzoatus;* Empl. Canthar.; Unguenta Iodi, Hydrargyri, Hydrarg. Nitratis, and Terebinthinæ,
Hungary.	*Acetum, Emplastrum, Tinctura,* and *Unguentum Cantharidis; Charta Epispastica; Liquor Epispast;* Emplast. Calefaciens.
...	*Cera Alba;* Pil. Phosphori; Emplast. Calefaciens, Cantharidis, Galbani, Picis, Saponis fuscum; Unguenta Cantharidis, Hydrarg. Co., Picis Liquid., Resinæ, Sabinæ, Terebinthinæ.
Pacific and Indian Oceans.	Charta Epispastica; *Unguentum Cetacei.*
Mexico and Teneriffe.	*Tinctura Cocci;* Tinct. Cardam. Co.; Tinct. Cinchonæ Co.
...	...
Spain, France, Italy, Hungary.	...
...	Mistura Scammonii.
...	*Mel Boracis; Mel Depuratum; Oxymel; Oxymel Scillæ;* Conf. Piper; Conf. Scammon.; Conf. Terebinth.
Coasts of Norway, France, and England, Newfoundland and Labrador.	...
Native of Central Asia, imported from China and India.	...
...	Mistura Spiritus Vini Gallici.
...	Pulv. Elaterini Comp.

III. A CHART OF THE VEGETABLE SUBSTANCES.

Arranged in Reference to their being Organs and Parts of Plants.

Roots.	*Rhizomes.**	*Woods.*	*Barks—continued.*	*Leaves—continued.*	*Flowers and Buds—continued.*	*Fruits or parts of Fruits—continued.*	*Seeds.*	*Herbs.*	*Special Vegetable Products—continued.*
Aconitum	Arnica	Guaiacum	Rhamnus Frangula	Buchu	Rosa Centifolia	Cassiæ Pulpa	Amygdalæ	Lactuca	Chrysarobinum
Armoracia	Cimicifuga	Hæmatoxylon	Rhamnus Purshiana	Coca	Rosa Gallica	Citrus Limonum	Cardamomum	Lobelia	Gossypium
Belladonna	Filix Mas	Pterocarpus	*Excrescence.*	Conium	Sambucus Nigra	Colocynthis	Colchicum	Cusso	Saccharum
Calumba	Gelsemium	Quassia	Galla	Digitalis	Santonica	Conium	Hordeum Distichon	*Whole Plant.*	Theriaca
Gentiana	Podophyllum	*Barks.*	*Tops. (Branches.)*	Hyoscyamus	*Fruits or parts of Fruits.*	Coriandrum	Linum	Chirata	*Juices.*
Glycyrrhiza	Serpentaria	Canella	Cannabis Indica	Jaborandi	Anethum	Cubeba	Myristica	*Fungi.*	*Dried:—*
Hemidesmus	Valeriana	Cascarilla	Sabina	Laurocerasus	Anisum	Ecballium	Nux Vomica	Cerevisiæ Fermentum	Aloe
Ipecacuanha	Veratrum Viride	Cinchonæ	Scoparium	Matica	Anisum Stellatum	Ficus	Physostigma	Ergota	Gutta Percha
Krameria	Zingiber	Cinnamomum	*Leaves.*	Senna	Aurantium	Fœniculum	Sabadilla	*Lichens.*	Kino
Pareira	*Tubercle.*	Cusparia	Aconitum	Tabacum	Bela	Lupulus	Sinapis	Cetraria	Manna
Pyrethrum	Jalapa	Granati Radicis Cortex	Belladonna	Uva Ursi	Capsicum	Papaver Somniferum	Staphisagria	Litmus	Opium
Rheum	*Corm.*	Larix		*Flowers and Buds.*	Carum Carui	Pimenta	Stramonium	*Special Vegetable Products.*	*Sediment from Juice.*
Sarsa	Colchicum	Mezereum		Anthemis		Piper	Triticum Sativum	Amylum	Elaterium
Sassafras	*Bulb.*	Nectandra		Caryophyllum		Prunus	*Glands.*	Catechu	
Scammonium	Scilla	Quercus		Crocus		Rosa Canina	Kamala		
Senega				Papaver Rhœas		Tamarindus	Lupulin		
Sumbul						Uvæ			
Taraxacum									

* Rhizomes are semi-subterranean creeping stems; corms, bulbs, and tubers are fleshy root-stocks; glands are small cellular organs which secrete essential oils and resinous products; they are sometimes sunk in the tissues as in the peel of orange, or frequently raised above their surface and readily removed by shaking or rubbing, *e.g.*, *lupulin*, *kamala*. Fungi and Lichens are cellular cryptogams—plants in which there is no marked distinction into root, stem, and leaves. For a synopsis of a course of lectures and laboratory work in Botany, to be attended by pharmaceutical students before entering upon the study of the vegetable materia medica, see *Appendix*.

The Principal Characteristics of Crude Vegetable Material.[1]

Inasmuch as by far the largest proportion of the vegetable drugs are drawn from the more highly organised members of the vegetable kingdom (the *Phanerogamia* or "Flowering plants"), the following remarks apply to material of this category:—

Cells.—The substance of plants is built up of structures termed "cells," which, like the external form of the plant, have likewise undergone regular changes in size and structure according to their individual life-history. Since the cells of plants in the very young state differ but slightly from one another, these differences are best seen in cells which have passed through their earlier stages, as found in such organs as young stems, roots, leaves, and fruits.

When the cell has reached its stage of greatest activity, it will generally be found to consist of three concentrically-arranged parts—(1) the firm elastic outer wall, the *cell-wall;* (2) the soft, inelastic, semifluid, albuminous substance inside the wall, called *protoplasm,* in which is generally imbedded a more solid rounded body, the *nucleus;* and (3) the watery fluid occupying the centre, the *cell-sap,* which during the growth of the cell ultimately coalesces, forming drops or vacuoles. The formation of new cells is effected by the rearrangement of a protoplasm-mass around a new centre, from which is subsequently developed a new cell-wall. The three types of growth are distinguished as (1) *rejuvenescence,* when a new cell is formed from the whole of the protoplasm of a cell already existing; (2) *coalescence,* when two or more masses unite in the formation of a new cell; (3) *multiplication,* when by the splitting up of the protoplasm two or more are formed from a single cell.

The Cell-Wall.—The substance of the cell-wall (cellulose with varying proportions of water and inorganic matter) is secreted from the protoplasm, its mode of growth varying according to the specific function which it has to fulfil in the economy of the plant. Its growth only continues so long as it is in immediate contact with the protoplasm, it being effected by the intercalation of additional solid matter between those already existing in the membrane, the process being termed *intussusception.* Cells during growth assume a variety of forms, such as hexagonal, stellate, tabular, elongated, fusiform, &c.; the method in which the walls become thickened also takes place in a very irregular manner, affording characteristic appearances in the form of annular or spiral ridges, or, if the wall is very thick, channels or fissures may be left, passing entirely through the wall into the cavity of the cell, and thus giving it a dotted or pitted appearance. The thickenings also generally assume a striated appearance, varying according to their density. Cellulose when treated with Schulze's solution or with iodine and sulphuric acid (diluted with an equal volume of water) assumes a blue colour. Chemical changes may also occur in the cell-wall attended with different physical properties; it may undergo (1) the cuticular change, or become *suberous* (as in

---

[1] See remarks on page 91.

the cuticle and in cork), turned yellow with Schulze's solution[1] [in true cork-cells the wall is entirely changed, whereas, in the cuticle of the epidermis, spores, and pollen grains, only the outer part becomes cuticularised, the inner part remaining unaltered cellulose]; (2) *lignification*, the cellulose becoming converted into lignin, hard and inelastic, yellow with Schulze's solution; (3) degradation or the *mucilaginous change* giving it a gelatinous consistence, to which such substances as gum arabic, tragacanth, myrrh, and other gum-resins probably owe their origin.

Mineral matter, such as silica and calcium carbonate, is also largely deposited in the cell-wall.

Protoplasm is a soft plastic combination of proteid or albuminous matter, water, and small quantities of mineral constituents. It is the seat of all vital processes of the cell, from which are secreted numerous substances of different chemical and physical properties, such as oil, chlorophyll, crystalloids, aleurone grains, starch, and fat, in which case it assumes a more or less granular appearance. Living protoplasm does not readily absorb colouring matter dissolved in water, nor allow its passage. When the granular protoplasm is contained in an outer layer free from granules, the latter is termed *ectoplasm;* but if by the coalescence of the cell-sap into vacuoles the protoplasm forms a thin layer just within the cell-wall, it is called the *primordial utricle.*

Substances contained in the Protoplasm.—*Chlorophyll* in the higher plants occurs in the form of granules in certain cells, such as those of the leaf and young portions of the stem, constituting the green colouring matter of plants. Each granule consists of two parts, the colouring matter and its colourless protoplasmic vehicle: the former may be readily removed by such solvents as benzol, ether, alcohol, chloroform or essential and fixed oils leaving the latter colourless material behind. These chlorophyll-corpuscles grow and increase in number by division of their substance. In the lower orders of plants, as in certain Algæ and Lichens, the corpuscles do not always occur in the form of granules, but the protoplasm in addition to the green colouring matter contains also red, blue, and yellow substances soluble in water, causing, by their admixture, the verdigris-green, red, brown, or buff colours of those plants; with which latter must not be confounded the autumnal and fructescent tints—due to *degradation* of the chlorophyll. Solution of chlorophyll is bright green by transmitted, and red by reflected light, the spectrum showing 7 absorption-bands, the strongest being between the lines B and C of the solar spectrum. When plants are deprived of light they undergo *etiolation*—that is, the granules are formed but not the green colouring matter; the same is said to occur when the plant is deprived of

---

[1] *Schulze's Solution.*—Prepared by dissolving zinc in pure hydrochloric acid, and evaporating the solution, on a water bath, in the presence of metallic zinc until it has a syrupy consistence; it is then saturated with potassium iodide, and then with iodine; a few grains of iodine should be left in the liquid after it is poured off for use. It may also be prepared by dissolving 25 parts of pure fused zinc chloride and 8 parts of potassium iodide in $8\frac{1}{2}$ parts of water, filtering through asbestos and saturating with iodine.

Schulze's Macerating Fluid.—One gramme of potassium chlorate is dissolved in 50 c.c. of nitric acid; the tissue is then placed in a small quantity of it, and the whole is boiled for a short time in a test-tube; the liquid is poured off, and the residue is well washed with water. A filter may be used for washing.

The cells become isolated in consequence of the solution of the middle lamella.

iron as a constituent of its mineral food, it then being designated *chlorotic.* The process of assimilation, or the fixing of carbon derived from the atmosphere, depends upon the action of the chlorophyll upon carbonic acid gas in the presence of water under the influence of sunlight; notably, starch granules are developed thereby which may be readily recognised by the application of solution of iodine, after abstraction of the green colouring matter by alcohol. The colour-substances in the petals of flowers are termed *chromatophores.*

Protoplasmic Crystalloids.—Portions of the protoplasm sometimes assume a definite crystalline appearance, not to be confounded with the inorganic crystals which occur in the cell-sap. Their substance consists necessarily of protoplasm, and is distinguished from the crystals of the cell-sap by its capability of imbibing water and swelling up under the influence of such reagents as caustic potash. They assume the forms of octohedra, tetrahedra, and rhombohedra, and occur largely in the tubers of certain kinds of potatoes, in fatty seeds such as those of castor-oil and brazil-nut.

Aleurone grains are granules of a proteid nature found chiefly in ripe seeds (in the endosperm and cotyledons), generally associated with starch and oily matter. They often contain protoplasmic crystalloids, together with small rounded bodies called *globoids,* the latter consisting of a combination of phosphoric acid with lime and magnesia.

In castor-oil seeds, the aleurone grains contain both protoplasmic crystalloids and globoids.

Starch occurs in the form of granules of a concentrically stratified structure consisting of starch, water, and a small percentage of incombustible mineral matter, found in certain cells of almost all plants. It occurs largely in tubers and other reserve receptacles and in the seeds of cereals. Starch is a carbohydrate isomeric with cellulose, to which latter it bears great resemblance in properties. A starch grain is composed essentially of two parts, a thin outer envelope or membrane termed *starch-cellulose* (forming about 5 per cent. of the grain), and of a semi-solid substance contained within termed *granulose,* more easily soluble, and in the presence of water assuming a beautiful blue coloration with iodine.

Starch is very widely distributed in plants, the granules often assuming characteristic appearances; their growth takes place by *intussusception,* generally in concentric rings arranged round an eccentric nucleus or *hilum.*

Starch grains are insoluble in cold water, but when crushed, a small portion of the granulose is dissolved. Caustic potash solution causes intense swelling. Water at 60° C. causes the rupture of the starch-cellulose with the escape of the contents, leaving the membrane as a skeleton.

The Cell-Sap.—The cell-sap consists of an aqueous solution of various substances, such as mineral salts, cane and grape sugar, tannin and other glucosides, inulin, vegetable acids as citric and malic, and many colouring matters. It pervades the whole cell (the cell-wall, protoplasm and all bodies contained in it), occasionally separating into *vacuoles.* Most substances elaborated by the protoplasm are found in it either in solution or in visible and definite forms; mineral constituents, especially, are apt to crystallise out and in several instances become deposited upon the cell-walls. In certain plants (as in the hypodermal cells of *Ficus elastica*) a peculiar ingrowth of the cell-wall takes place, which becomes coated in a globular manner with crystals of calcium carbonate—such globular masses are termed *cystoliths.* All other crystals hitherto observed have been found to consist of calcium oxalate, which crystallises in two systems, octahedral and acicular (clinorhombic), according to the amount of water contained. Acicular crystals of calcium oxalate are termed *raphides;* they are secondary products of metastasis, the excess of calcium salts absorbed from the soil being thus eliminated.

Aggregation of Cells to form Tissues.—Every aggregation of cells governed by a common law is termed a tissue. True tissues generally consist of cells formed by repeated division of one or more mother-cells. According to their arrangement in space, the following combination of cells may be distinguished: (1) *filaments*, where the cells are connected only by their contiguous ends, and so form a filament, as in many fungi and lichens; (2) *surfaces*, when the cells form a single layer, and are in contact in two directions of space (length and breadth), as in many algæ and leaves of mosses; (3) *masses*, when the cells are in contact on all sides.

Formation of the Common Wall of Cells combined into a Tissue.—The common wall of cells combined into a tissue is, in the first instance, extremely thin. As it increases in thickness a *middle lamella* generally becomes visible, which divides the wall into two parts, one of which apparently belongs to each of the contiguous cells. The middle lamella is nothing more than a specially differentiated part of the wall which belongs to both of the cells in common. Its chemical composition being different from that of the remainder of the wall permits of its solution in nitric acid and chlorate of potassium (Schulze's macerating fluid), so that the individual cells may be separated. The markings on cell-walls generally occur symmetrically on each side of the middle lamella, the pores on the one side corresponding to the pores on the other, except in the case of spiral, annular, and reticulated markings. Under certain circumstances, the walls of tissue-cells become wholly or partially absorbed, bordered pits and sieve-vessels being instances of the latter. When complete absorption in the transverse walls separating cell-rows in the higher plants occurs, a cell fusion or true *vessel* is formed. The true vessels of plants, including laticiferous vessels, are examples of cell-fusion.

Intercellular Spaces.—After the rapid growth of the thin cell-walls, the middle lamella so divides as to leave triangular intercellular spaces or lacunæ, abundantly met with in certain tissues. When the splitting of the middle lamella is carried to the furthest possible extent, the cells separate, as in the dehiscence of many fruits. Intercellular spaces, large and small, generally contain air—as in many water-plants (*e.g.*, *Nuphar*). These spaces must not be confounded with the large cavities met with in the hollow stems of many grasses and umbelliferous plants, caused by the drying-up and rupture of masses of tissue. The intercellular spaces of many plants become internal receptacles of secretion containing a variety of substances, such as mucilage, milky-juices (yielding, when inspissated, such bodies as opium and caoutchouc), resins, oils, &c. The cleft of the stomata of the epidermis belongs to the category of intercellular spaces.

Forms and Systems of Tissues.—As previously stated, a tissue is an aggregation of cells, such aggregations characterised by those properties which the cells possess in common, and differing from those which surround them, being said to form a distinct tissue. According to the form and relative positions of the cells, two forms of tissue may be broadly distinguished; *parenchyma*, in which the cells are not much longer than they are broad, and *prosenchyma*, in which the cells are much longer than they are wide, and overlap by their ends. When the cell-walls of either *parenchymatous* or *prosenchymatous* cells are much thickened, the tissue is called *sclerenchyma*. Cells of a tissue which have ceased to divide, and have assumed their definite form, constitute a *permanent* tissue. A tissue in which, however, certain cells continue to subdivide, whilst the others are being converted into permanent tissue, is called a generating tissue, or *meristem*.

Primary meristem comprises the whole of the cellular tissue of very young organs, as the apices of roots and stems, the youngest leaves and embryo;

from it are developed the later forms of tissue. *Secondary meristem* occurs in those organs which have undergone differentiation into tissues, usually found in thin layers, as in the *cambium* ring occurring between the cortex and inner vascular system.

The three systems of tissues of which vascular plants are generally built up, their arrangement varying according to the member of the plant in which they occur, may be divided into—

1. *Epidermal tissue*, which covers the exterior of the plant (in the younger states) usually consisting of one or more layers of cells without any intercellular spaces, except special openings termed stomata.

2. *Fibro-vascular tissue*, traversing the plant longitudinally in the form of bundles, characterised by the presence of sieve-tubes, vessels, and of fibrous prosenchyma.

3. *Fundamental tissue*, which fills up the rest of the space, consisting principally of parenchyma.

Both parenchyma and prosenchyma may occur in all three systems.

Epidermal Tissue.—In the higher plants the outermost layer of cells constitutes the true epidermis, generally consisting of a single layer of cells without any intercellular spaces except stomata: from certain plants, as in the leaves of *Begonia*, it may readily be stripped off as a thin transparent membrane. In the earliest stages, and in the lowest forms of plants, the epidermal system is, however, not sharply defined from the fundamental tissue, and appears to be no more than the outermost layer of the latter. Epidermal cells are generally brick-shaped or tabular in form and are destitute of chlorophyll, but occasionally may contain other colouring matters in solution. The outermost wall is more thickened than the other walls, and is always cuticularised, and on that account termed *cuticle*, extending over the whole of the epidermis. Particles of wax are included in the cuticle of numerous plants, thus preventing their surfaces from being wetted by water; wax may also be found on the surface in the form of thin flakes or granules, constituting what is popularly known as bloom (*e.g.*, plum or grape), sometimes occurring in considerable quantity (*e.g.*, fruits of *Myrica cerifera*, trunks of palms,—*Ceratoxylon* and *Klopstockia*).

Stomata are openings in the epidermis admitting air into the interior of the plant, or permitting gases or aqueous vapour to escape, and are in connection with the intercellular spaces and air cavities. Each stoma consists of two peculiarly modified epidermal cells called *guard-cells*, which latter, when viewed from the surface, may be readily recognised surrounding the opening of the stoma. Stomata are found on nearly all parts of terrestrial plants which are above ground, are particularly abundant on leaves, usually absent from submerged organs, and are always absent from roots.

Hairs are products of the epidermis, usually outgrowths of single epidermal cells. A hair may consist of a single cell, as in the hairs of young roots and of the testa of the seed of Gossypium, which constitutes cotton; the outgrowth from the epidermal cell may also undergo various divisions, as in the scales (*ramenta*) on the leaves of ferns, or hairs on ivy (*Hedera Helix*), causing a stellate appearance.

A gland may be defined as a group of cells (generally found underneath the cuticle) sharply differentiated from those which surround them, whose intervening septa have become absorbed, so that a single cavity is formed in which excrementitious products are secreted, especially volatile oils (as in the rind of various species of *Citrus*). The nectaries of flowers are gland-like bodies. Hairs may become glandular either at their apex (*e.g.*, *Primula sinensis*) or base (*e.g.*, the glandular hairs or stings of the Nettle (*Urtica dioica*). Digestive glands, which secrete a fluid capable of dissolving various

foreign bodies, are peculiar to certain plants, as in the tentacles (hair-like appendages) of the leaf of *Drosera.*

Periderm or **Secondary Limitary Tissue.**—Parts of plants which are of long duration, or which increase greatly in diameter, as the stems of dicotyledons and the tuber of potato, soon lose their epidermis, and a new or secondary limitary tissue takes its place. It consists of flattened or brick-shaped cork-cells, arranged regularly in rows parallel to the surface of the part on which they are developed. These cells are filled with air, and give the reactions for cork, and are generally impermeable to water; they are formed from the cork-cambium or *phellogen*, (cells containing chlorophyll, being called the *phelloderma*). This cork-layer is called the *periderm* (*e.g.*, the cork from the cork-oak, *Quercus suber*), formed in annual rings from the phelloderma as the ordinary cambium forms rings of wood. In an ordinary tree, the youngest twigs are covered by the epidermis, the young branches by periderm, and the trunk by true bark; all three stages depending upon the age of the part.

Lenticels.—In the periderm there are organs corresponding to the stomata of the epidermis, serving like them to admit air to the living portion of the cortical tissue; these are termed lenticels. In the earlier stages of the plant they constitute small masses of cork-cells formed under the epidermis, giving rise to peculiar brownish spots—not to be confounded with glands.

Fibro-Vascular Tissue.—As previously stated, this tissue extends throughout the body of the higher plants in the form of bands or bundles. When the cells of which they are composed are much harder than those of the fundamental tissue, they can be readily separated as shreds from the tissue surrounding them ; they may be met with in the leaves, stems, and roots of the majority of plants, and are termed vascular or fibro-vascular bundles. In many cases they occur so closely packed and so strongly developed that very little of the soft fundamental tissue remains, in which case they constitute the wood of trees. In the petiole or leaf-stalk, in the stem, and generally in all organs which increase in length, the fibro-vascular bundles run longitudinally, a transverse section of such organs exhibiting therefore transverse sections of their fibro-vascular system. The fibro-vascular bundles traversing the stem are regarded as being merely the lower portions of those which come from the leaves; hence such bundles form the venation of leaves, and by the decay of the softer tissues in the latter they persist as a skeleton. In Dicotyledons and Gymnosperms the bundles of each leaf on entering the stem run downwards parallel to each other at about an equal distance from the axis; transverse sections of such stems, therefore, exhibit the bundles arranged in a circle concentric with the circumference, and dividing the fundamental tissue into two portions, the inner constituting the *pith* or *medulla*, the outer the *cortex.* Those portions of fundamental tissue lying between the fibro-vascular bundles in the circle, and which therefore connect the pith and the cortex, are called *medullary rays.*

[Roots differ widely from stems and leaves in the arrangement of their fibro-vascular system, and will be considered later.]

Xylem or **Wood**, and **Phloëm** or **Bast.**—A well-developed fibro-vascular bundle consists of xylem and phloëm, the former xylem or wood-cells tending to become lignified and filled with air, constituting the firm and brittle portion of the bundle; the latter tending to the formation of softer and more flexible cell-walls, which are but slightly lignified, and contain cell-sap.

Fibro-vascular bundles consisting only of these two forms of tissue are incapable of further growth, and are said to be *closed ;* whereas, those which possess throughout their length, in addition, a layer of generating tissue

(meristem), the *cambium*, which, by the active growth and divisiou of its cells, increasing the bulk of both xylem and phloëm between which it lies, are said to be *open.*

The xylem or *wood* of a fibro-vascular hundle normally consists of the three following elements:—

1. *True vessels* (*tracheæ* or *ducts*), formed from superimposed cells, the transverse walls of which have become absorbed ; according to the manner in which they have become thickened, they may be distinguished as spiral, reticulated, annular, scalariform, or pitted vessels, containing in their cavities either air or water.

2. *True wood-fibres* or *cells*, consisting of lengthened, overlapping, narrow prosenchymatous cells.

3. *Wood-parenchyma* still containing protoplasm (frequently wanting).

The Phloëm or *Bast* of a fibro-vascular bundle consists of :—

1. *Vascular elements*, the sieve-tubes, possessing thin side walls with thick transverse septa, perforated with closely-set, open canals ; they contain albuminous substances.

2. *Prosenchymatous bast-fibres*, which are often long and much thickened, hut flexible.

3. *Elongated parenchymatous soft bast.*

The most frequent arrangement in Gymnosperms and Dicotyledons is, that the xylem and phloëm in each bundle lie one behind the other on the same radius, the xylem being nearer the centre of the stem, and the phloëm consequently towards the periphery or circumference. In open bundles the cambium lies between the xylem and phloëm ; annular and spiral vessels form the innermost portion of the xylem towards the centre of the stem, and the outer portion, towards the phloëm, consists of reticulated and pitted vessels, which are the largest of all the elements of the xylem.

In the phloëm the bast-fibres generally lie nearest the circumference, and the sieve-tubes, which are generally conspicuous by their larger apertures (in the transverse section), are seattered in the soft bast.

In some Monocotyledons, and in ferns, a transverse section of the closed fibro-vascular bundle shows the xylem portion in the middle completely surrounded by the phloëm, which consists chiefly of soft bast.

Fibro-vascular Bundles of the Root.—These differ very much in structure from those enumerated above. A cylindrical mass of fibro-vascular bundles (sometimes containing a pith) generally occupies the axis of the root. In this several xylem-hundles are regularly distributed, and alternating with them radially lie an equal number of phloëm-bundles, the latter in Monocotyledons being more numerous. In each xylem-bundle the spiral vessels lie nearer the circumference. The layer external to the fibro-vascular system is known as the *pericambium*, from which the rudiments of the lateral roots are usually formed ; in the course of their fuller development, a fibro-vascular system also occurs in direct connection with that of the main root.

Adventitious root-fibrils and hairs appear to be only lateral extensions of the pericambium.

Growth and Thickness of Stem and Roots.—Growth and increase in thickness among Gymnosperms and Dicotyledons is effected by the continuous activity of the cambium of their open fibro-vascular hundles. This activity thus gives rise to *secondary* xylem or wood, and *secondary phloëm* or bast, as distinguished from the primary constituents of the bundle which existed previously. The primary wood of the bundle is hence the inuermost part of it, and usually projects into the pith, especially when the primary bundles lie rather far apart ; it then constitutes the medullary sheath.

The secondary wood of trees contains the following elements :—

1. Vessels—usually provided with bordered pits, *their diameter being greater than that of the other elements.*

2. Wood-fibres—much elongated, longer than the cambium-cells, with the ends growing between one another.

3. Wood-parenchyma—formed by the repeated transverse division of the cambium-cells.

In addition to the elements already alluded to, the wood includes certain parenchymatous cells which are elongated in a radial direction ; they are termed medullary rays, and are generally brick-shaped.

The wood of many timber trees frequently exhibit a characteristic difference between the older internal portion of the wood (*duramen*), and the younger outer portion (*alburnum* or sap-wood), the altered heart-wood or duramen containing less water, no starch in its parenchyma, and is often darker coloured (*e.g.*, *Guaiacum* and *Oak*). The secondary bast, formed from the cambium, consists chiefly of sieve-tubes, bast-fibres, and parenchymatous cells.

The tissues lying externally to the cambium are collectively designated *cortex.* The cells of the cambium ring are rich in protoplasm, tear very readily, especially during active growth, thus enabling the cortex to be readily stripped from the wood.

Fundamental Tissue.—The ground or fundamental tissue includes all the internal masses of cells inside the epidermis which does not form part of the fibro-vascular bundles. Various forms of cells and of tissues occur in it, and those parts of it in particular which lie in immediate contact with other tissue systems are frequently remarkable for peculiarities of structure. Specially modified forms of fundamental tissue which occur in close connection with the epidermis are designated *hypoderma*—a distinct form of the latter occurring in the stems and petioles of Dicotyledons, in which the cells are thickened along the line of contact and at the angles where the cell-walls meet, is called *collenchyma* (*e.g.*, petiole of *Begonia*).

Endodermis.—This term is applied to the single layer of cells enveloping as a sheath the fibro-vascular bundles in plants having a vascular axis ; it is invariably present in roots, the walls of the cells being cuticularised. In many palms and grasses, the cells of this sheath appear to have undergone a special modification, constituting thick-walled parenchymatous cells.

The rest of the ground-tissue, which forms as it were a padding between the other tissues, is generally parenchyma containing intercellular spaces. In the leaf this intermediate tissue is distinguished as *mesophyll* (the cells containing chlorophyll in their protoplasm), whereas, in the majority of roots, stems, and succulent fruits, it is colourless. In various parts of the ground-tissue sclerenchymatous cells may occur in groups, as in the pear (*Pyrus communis*) ; or in massive sclerenchymatous tissue of uniform consistence, as in the stones of drupaceous fruits. In dicotyledonous stems, the pith, inner cortical tissue, and the primary medullary rays, all belong to the fundamental or ground tissue.

Palisade Parenchyma.—The chlorophyll-containing ground-tissue of the leaf is generally of a different texture at the two surfaces of the leaf; the upper tissue usually consists of cells arranged at right angles with the surface, termed *palisade parenchyma* ; whereas, on the under-surface, the cells are generally irregularly arranged (*spongy parenchyma*), and are separated by intercellular spaces.

Vessels and Cells with Special Contents.—Distributed throughout the three systems of tissues (Epidermal, Fibro-vascular, and Ground-tissue) structures are met with, which are distinguished by their contents. These may be

formed and transported through the plant either by special cells or by anastomosing vessels, or by the intercellular spaces. Laticiferous vessels are fusions of cells running in a most irregular, reticulated manner throughout the plant (to be seen in such plants as the Dandelion and other *Compositæ*, in *Campanulaceæ*, *Lobeliaceæ*, *Convolvulaceæ*, *Papayaceæ*, *Papaveraceæ*, *Coniferæ* (intercellular—resin and gum), *Araceæ*, *Moraceæ*, *Euphorbiaceæ*, *Asclepiadaceæ*, and *Apocynaceæ*). These cells contain a fluid termed *latex* (generally of a milky appearance, yellow in *Chelidonium*), from which are derived many important substances used in medicine and in the arts (such as Opium, Scammony, gums of various kinds, Caoutchouc (India-rubber), Gutta-percha, &c.).

Internal cells (usually isolated), containing special substances of an oily or resinous nature, are generally designated as *glands*.

MANIPULATION, PROCESSES, AND PREPARATIONS (see p. 91).

I. The Application of Heat.—A convenient stove suitable for a small pharmaceutical laboratory is shown in fig. 49; it contains a still with movable top and condensing apparatus, a copper pan or water-bath (for extracts, &c.), other smaller porcelain dishes fitting into openings into the boiler (for processes of digestion, solution, liquefaction, &c.), a sand-bath, and other accessories. The apparatus under notice is not constructed, however, for the use of steam under pressure.

"Temperature in all cases, excepting where otherwise stated, is to be determined by Fahrenheit's thermometer (but in every case the equivalent on the Centigrade scale is added in brackets), and specific gravities are to be taken at the temperature of 60° F.

"When a *water-bath* is directed to be used, it is to be understood that this term refers to an apparatus by means of which water or its vapour, at a temperature not exceeding 212°, is applied to the outer surface of a vessel containing the substance to be heated, which substance may thus be subjected to a heat near to, but necessarily below, that of 212°. In the *steam-bath* the vapour of water under pressure at a temperature above 212°, but not exceeding 230°, is similarly applied" (*Brit. Pharm.*).

The steam-bath is applicable where the ordinary operation of "boiling" is required, as in the preparation of decoctions, &c.

Saline baths (saline "water-baths") are saturated solutions of ammonium chloride or other salts—boiling at about 230° F.

Evaporation in a Current of Warm Air.—Usually effected in apparatus termed *drying-closets*, which should be supplied with a

copious draught of *dry* warm air at 120° F. entering at the top, exit at base: the two "extracts of aloes" and the "scale" com-

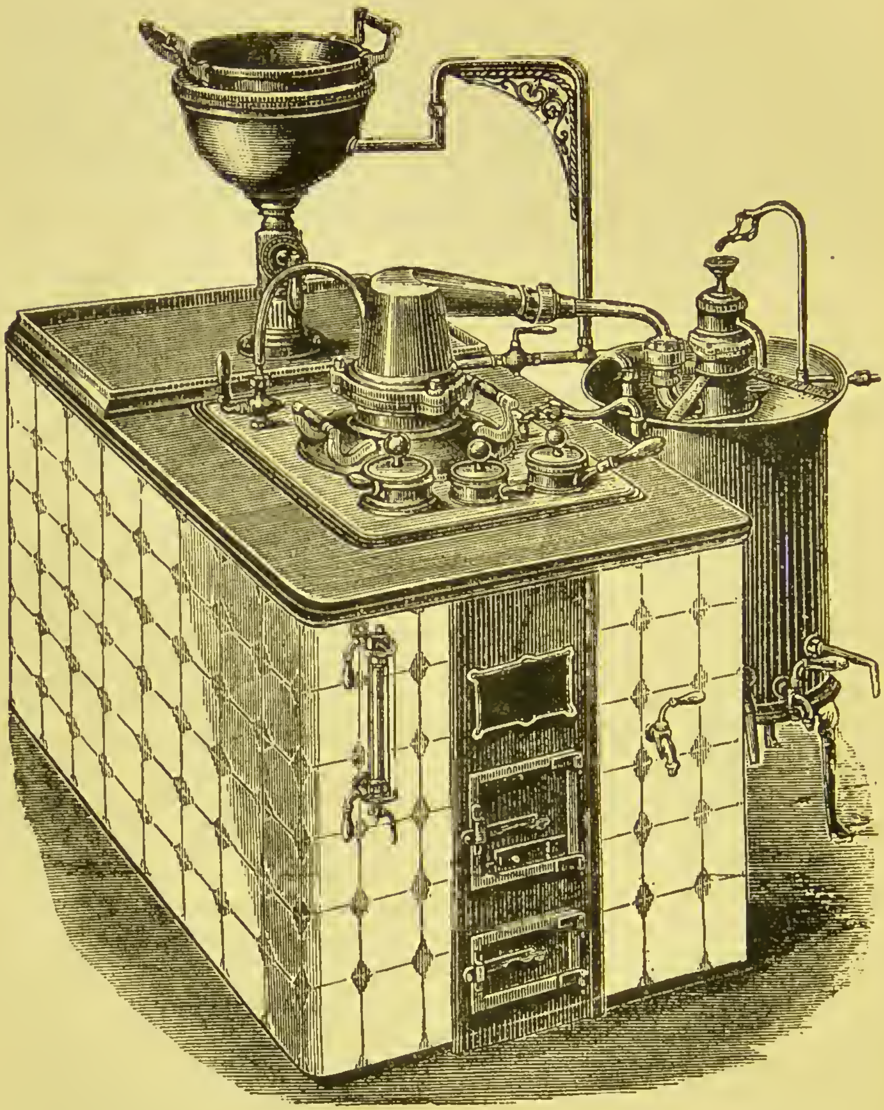


FIG. 49.—Stove suitable for a Pharmaceutical Laboratory.

pounds are directed to be thus evaporated. The apparatus is specially serviceable for drying all kinds of vegetable matter.

A sand-bath consists of ordinary sand heated on an iron plate or dish. While it prevents rapid changes of temperature, it affords no security against excessive heat.

Inspissation expresses the concentration of animal or vegetable juices by evaporation either spontaneously (*e.g.*, *Opium*), or by the heat of a water-bath (*e.g.*, *Fel Bovinum purificatum*, the "Extracta," *Cataplasma Conii*, *Pilula Scammonii Composita*, &c.)

Liquefaction is a term used to express the operation of melting resin, wax, or such other substances as pass through intermediate changes of softness before they become fluid, as exemplified in the directions for preparing the pharmacopœial "Emplastra" and those "Unguenta" containing resin, wax, or hard paraffin, and the "Suppositoria" containing Oleum Theobromatis as the basis. *Fusion* is the term generally applied to mineral substances (*Argenti et Potassii Nitras*, *Potassa Sulphurata*, &c.). For liquefaction under water at 140° F., see the preparation of *Pilula Phosphori* (*Brit. Pharm.*).

Liquefaction may generally be effected by means of a water-bath (*Adeps Benzoatus*); liquid substances to be incorporated with resin, wax, &c., should not be added until the latter are first liquefied.

Crystalline carbolic acid is converted into a permanent liquid at ordinary temperatures by the addition of 10 per cent. of water (*Acid Carbolicum Liquefactum*). Certain solids when rubbed together undergo liquefaction (*e.g.*, chloral hydrate and camphor in equal parts, used as a paint —*pigmentum*).

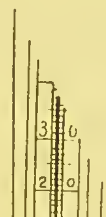


Fig. 50.

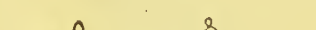


Fig. 51.

Melting-Point.—It is frequently desirable to ascertain the approximate purity of certain fats, waxes, and other substances used in pharmacy by observation of their melting-points. The pharmacopœial directions for ascertaining the melting-point of yellow wax (*Cera flava*) may be regarded as being typical of this

class of operation—viz., "liquefy a few grains, and draw a little of the fluid up into a capillary tube; fix a piece of the filled capillary tube to the bulb of a thermometer by thread (fig. 50); immerse the bulb and tube in a beaker of water, and heat the latter gently (fig. 51); at the moment the opaque rod of wax becomes transparent, *note the temperature.* The solidifying point is two or three degrees lower than the melting-point."

	Melting-Point.		Melting-Point.
Adeps præparatus, .	54° C.	*Paraffinum Molle*, .	35°–41° C.
Cera alba, ,, *flava*, . .	63° C.		
Cetaceum, . . .	44°–50° C.	*Menthol*, . . .	43° C.
Oleum Theobromatis, .	30°–35° C.	*Thymol*, . . .	43°–51° C.
Paraffinum Durum, .	44°–63° C.	*Acidum Carbolicum*, .	35° C.

Clarification.—*Aqueous* solutions which are turbid may frequently be rendered clear, without addition (when the liquid contains any principle coagulable by application of heat), by boiling the liquid, when such principle (*e.g.*, albumen) separates as a coagulum, enclosing within its meshes the solid particles which gave rise to the turbidity.

Honey is clarified or depurated by simply melting in a water-bath, and, after skimming, straining while hot through flannel, previously moistened with warm water (*Mel Depuratum*).

For a similar reason aqueous solutions of vegetable matter, whether turbid or not, are raised to the boiling-point and strained, to ensure the absence of coagulable albuminous matter, the retention of which might otherwise impair the preservation of the product; for illustration, in the preparation of extract of liquorice the directions are—to exhaust the root by maceration with water, *heat the liquor* to 212° F., and strain through flannel, then evaporate the strained liquid to the consistency of a plastic extract (*cf.* also the process for the green-extracts; *e.g.*, Ex. Aconiti, in *British Pharmacopœia*).

Concentrated aqueous solutions of vegetable matter, however (*cf. Brit. Pharm.; e.g.*, liquid extracts of liquorice, cascara sagrada, rhamnus frangula), contain in addition inert *mucilaginous* matter of an objectionable nature, which is not coagulable by heat; in such cases rectified spirit is added, not only to coagulate the aforesaid matter, but more especially to preserve the filtered finished product (see footnote on page 143, also "Succi").

To turbid aqueous liquids containing no coagulable matter, white of an egg which has previously been well whisked may be added, well mixed, and the whole heated to the boiling-point.

Alcoholic liquids are clarified by the addition of either a concen-

trated solution of isinglass dissolved in water, or by the addition of white of egg previously whisked with some of the liquid to be clarified; in this case heat as a rule is not applied, since, if the liquid be sufficiently alcoholic, the albumen will be coagulated in the cold.

In preparing *Oleum Phosphoratum*, the oil of almonds is first clarified by heating to 300° F., and filtering when cool, moisture and albuminous matter being thereby eliminated.

II. The Mechanical Disintegration and Comminution of Air-dry Vegetable Substances.[1]—To facilitate the extraction of the active principles of air-dry vegetable drugs by solvents, it is necessary that they be submitted to the preliminary operation of disintegration or comminution. The state or extent of disintegration proper for each drug varies with its nature and with the process to which it is to be subsequently submitted; the more compact or dense the structure of the drug, the greater (finer) the comminution required.

(1) *Coarse disintegration* (*a*), consisting of slicing, chopping, and bruising, for instance, is recommended for such substances as sassafras, cinnamom, dried orange-peel, and others containing volatile principles, also calumba, rhubarb, and gentian (ordered to be *sliced* in their infusion), just sufficient quantity being operated upon as is required for immediate use.

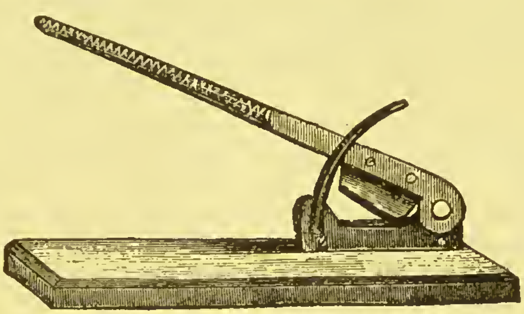


FIG. 52.—An apparatus for slicing and cutting.

(*b*) Consisting of producing coarse powders of *regulated com-*

[1] It is not desirable that drugs should be absolutely free from moisture; air-dry drugs contain as a rule from 8 to 12 per cent. of water, varying with the hygroscopic state of the atmosphere of the apartment where they are kept; they must, however, be kept free from *damp*. "Dried plants never represent entirely the fresh. The generation of valuable constituents during the drying process, as valerianic acid in valerian, must be regarded as exceptional. The alterations produced in drying consist of the volatilisation of a portion of the volatile constituents, and on the oxidation of most of the fixed and the remaining volatile constituents. During the drying process, the water in the cells is partly replaced by air, the influence of which upon the remaining constituents is intensified by the porosity of the dry plant. It is always advantageous to use fresh plants for the preparation of alkaloids and other active principles, and to employ as low a temperature as possible" (*Pharm. Jour.*, 2nd series, vol. xi. p. 86.)

minution[1] by means of sieves Nos. 20, 40, and 60. The drug to be operated upon is sliced into convenient lengths, and then ground

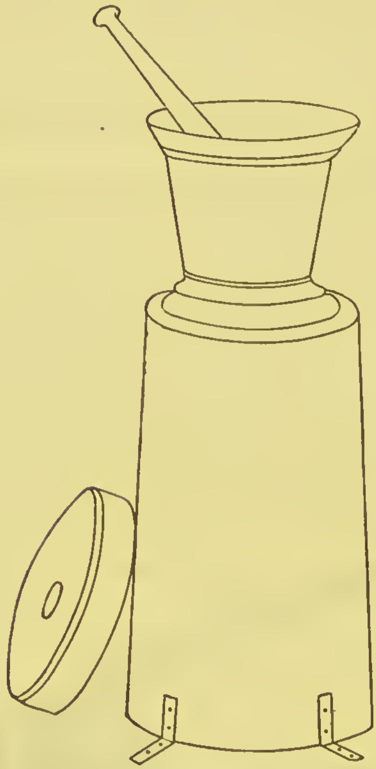


FIG. 53.—A metal mortar for bruising and beating (the latter term is applied to the mixing of pill-masses).

FIG. 54.—An iron mortar for small operations.

to powder in a steel mill, the degree of coarseness or fineness of the powder being regulated by means of a serew; for nearly all

[1] "Among the objects contemplated in revising the processes for the various preparations has been that of promoting increased uniformity of strength and other properties, espeeially in certain of the more active medieines. It will be found that this has been sueeessfully provided for in several instances. One of the means by which results of this kind are obtained in the aetion of liquid on solid ingredients consists in reducing the solid matter which is to be used to a nearly uniform state of disintegration, and then passing it through a sieve of a partieular-sized mesh. The degrees of disintegration are represented by numbers ranging from No. 20 to No. 60, these numbers indicating the numbers of parallel wires of ordinary thickness within a linear ineh forming the meshes of the sieves used" (*Brit. Pharm.*)

Fineness of Powders.—"As different degrees of fineness are necessary in powders, aceording to their nature and mode of treatment, the special degree required is designated in the several formulæ. For this purpose the terms very fine, fine, moderately fine, moderately coarse, and coarse are used; the

purposes an ordinary coffee-mill (with screw accessory) answers admirably.

Professor Redwood, in his lecture introductory to a short course of lectures on Galenical Pharmacy (*Pharm. Journal and Transactions*, 3rd series, vol. xvi.), states as follows :—

"A powder, say, for instance, No. 20, should consist of particles all of which will pass through a sieve the meshes of which are formed of parallel wires, of which there are twenty within a lineal inch, but only a few of which particles will pass through a sieve of say thirty wires to the inch. There is, no doubt, some difficulty in carrying out the specified object as fully as might be desired, and all that can be reasonably looked for is the exercise of intelligence and skill in accomplishing what is practicable. Carelessly and imperfectly prepared, a No. 20 powder may consist of particles three-fourths of which or more may be in almost an impalpable state, and then a critic using it for a preparation in which No. 20 powder is ordered exclaims, 'Here is a nice mess of a decoction.'

"In preparing these regulated powders on the small scale, I have found the American Enterprise Mill answer very well with a set of sieves, provided the drug, if it be of a hard ligneous character, or a bark, be previously cut up with some form of slicing knife, such as you see here in practical operation. I have thus succeeded very well in reducing pareira root to a No. 20 powder, with only a small proportion of fine powder in it, none of which was removed by sifting ; and pareira is one of the difficult drugs to operate on. At well-appointed drug mills, where there are stones of different weights, the use of the heavier stones would be avoided.

"But whatever method of operating may be adopted, it is important to avoid submitting the substance operated upon to too high a degree of comminution before commencing the separation of the powder which is being produced. The vegetable substance should be first broken into fragments, the greater part of which are, as yet, larger than those of the required powder, and when a certain quantity of the smaller fragments are about the required size, these should be taken out by the use of a sieve of the proper mesh. Then further comminution should be effected, and another separation with the sieve, and so on. The drug may be thus broken up by successive disintegration and sifting, so that the greater part shall consist of fragments of the required size, without materially altering the quality of the powder as compared with the unpowdered substance."

(2) *The Production of Impalpable Powders.*[1]—This is an industry in itself, relegated to the "drug-grinders" or "drug-millers." Steel mills being inapplicable, it is usually performed by means of a pair of ponderous stones of porphyry or granite termed "runners,"

powder passed through a sieve of eighty or more meshes to the linear inch being designated as *very fine;* through one of sixty meshes, *fine;* through one of fifty meshes, *moderately fine;* through one of forty meshes, *moderately coarse;* and through one of twenty meshes, *coarse*" (*Pharm. U.S.A.*).

[1] With the majority of drugs it is necessary to more effectually dry them previous to grinding; this is effected by exposing them until friable on shallow trays to a current of air in a "drying-room" heated by means of steam pipes, the atmospheric temperature most suitable for the purpose being about 120° F.

which, during their circuitous travel round the smooth steel bed or floor of the mill (fig. 55), not only exert their whole weight upon the substance, but an additional tearing or grinding action, produced in consequence of the outer and inner edges of the

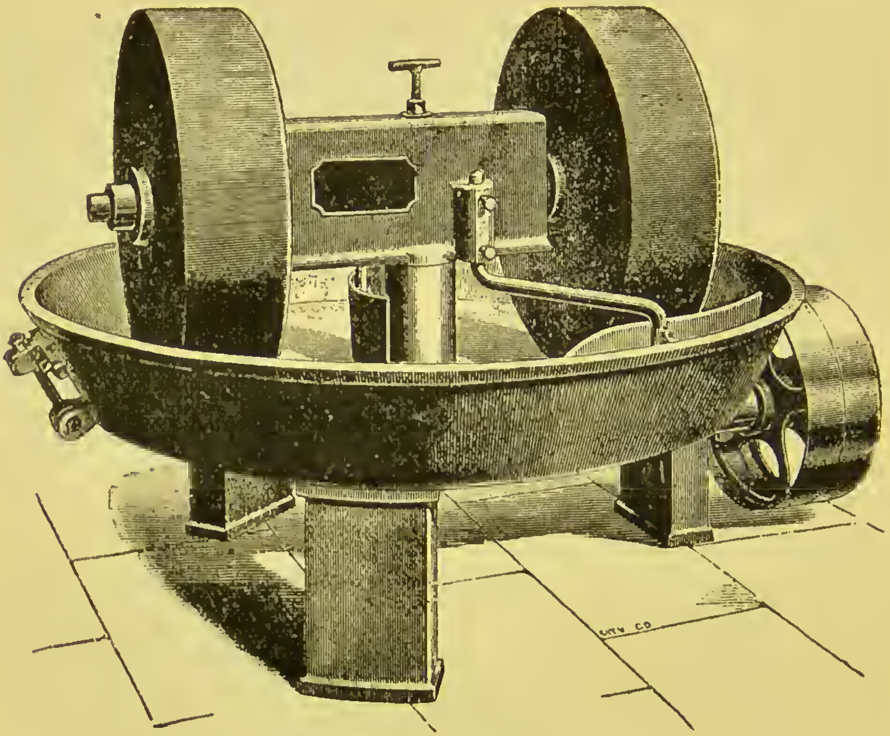


FIG. 55.—Drug-mill.

runners having to traverse very unequal distances during their circuit. The impalpable powders of those drugs which enter into the pharmacopœial compound *Pulveres* are thus produced.

"The degree of fineness to which substances should be reduced by pulverisation, in order to obtain and preserve their utmost efficacy, is a question of some importance. The impalpable form appears to be extremely injurious to some bodies, as to *Cinchona*, *Rhubarb*, *Guaiacum*, and to certain aromatics, in consequence, probably, of an essential part of their substance being dissipated, or changed, during the operation. Fabbroni, for instance, found by experiment that cinchona yielded a much larger proportion of soluble extractive when only coarsely powdered. I think it may be received as a general rule, that *extreme pulverisation assists the operation of all substances whose active principles are not readily soluble; and that of compound powders whose ingredients require*

intimate intermixture; whilst it certainly impairs the virtues of such as contain a volatile principle which is easily dissipated, or extractive matter which is readily oxidised" (*Paris' Pharmacologia*).

III. The Disintegration and Expression of fresh Vegetable Substances.—Fresh substances such as the leaves, young branches, and tops of aconite, belladonna, broom, hemlock, henbane, lettuce, and dandelion (fresh root) are first well bruised in large stone mortars (fig. 56), with broad pestles (made of hard wood), and then submitted to pressure.[1] Upon the large scale, however, they are usually crushed by "edge-runners," as in the drug-mill alluded to in the previous paragraph (2), and afterwards submitted to hydraulic pressure.

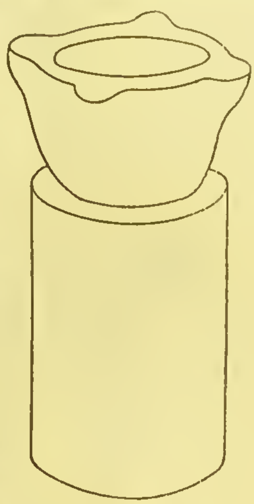


Fig. 56.—A stone mortar.

Fresh juices are preserved for pharmaceutical and medicinal use by the addition of one-third of their volume of rectified spirit (whereby chlorophyll and albuminous matters are precipitated), and allowing the mixture seven days to subside; finally decanting off the clear liquid, and filtering. Such products are the pharmacopœial *Succi*—

Succus Belladonnæ, ...	Dose 5 to 15 mins.
,, *Conii*, ...	,, ½ to 1 drm.
,, *Hyoscyami*, ...	,, ½ to 1 ,,
,, *Scoparii*, ...	,, 1 to 2 drms.
,, *Taraxaci* (from fresh roots gathered in autumn),	,, 2 to 4 ,,

There are also two other fresh juices obtained by expression (from the ripe fruits), viz., *Succus Mori* and *Succus Limonis;* they are used directly, however, for making the syrups of the same name.

Fresh juices are directly converted into *green extracts* by heating the juice to a temperature of 130° F. to coagulate the chlorophyll, the latter being removed by straining through flannel (fig. 57). The residual juice is then heated to 200° F., the coagulated albumin[2] removed and rejected; the filtered liquid is then

[1] Iron presses should always be kept exceedingly clean, or their use causes discoloration and black deposits with drugs and preparations containing astringent matters. The residue left in the press after the expression of substances is technically called a *marc.*

[2] The retention of the coagulated albumin would promote subsequent decomposition of the product, tending to the formation of moulds.

evaporated on a water-bath to the consistence of a thin syrup, the coagulated chlorophyll (passed through a hair-sieve) is then returned to the syrupy liquid, and the whole evaporated to a suitable consistence for forming pills. Such products are, *Extracta*

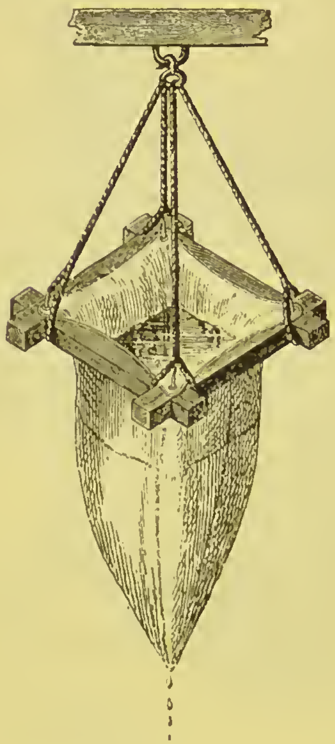


Fig. 57.—Flannel strainer. (After Hager.)

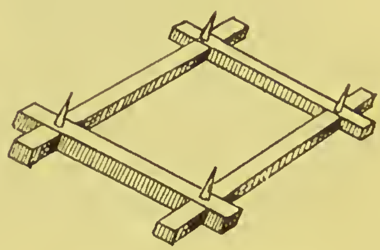


Fig. 58.—Straining-frame.

Aconiti, Belladonnæ, Conii, Hyoscyami, Lactucæ. In addition to the foregoing green extracts (five in number), it should be borne in mind that the two extracts of Colchicum and the extract of Taraxacum are likewise prepared from the fresh corms and roots respectively.

Green Extracts proper.	*Extractum Aconiti*, ...	Dose $\frac{1}{4}$ to 1 grain.
	,, *Belladonnæ*, . . .	,, $\frac{1}{4}$ to 1 ,,
	,, *Conii*, ...	,, 2 to 6 grains.
	,, *Hyoscyami*, . . .	,, 5 to 10 ,,
	,, *Lactucæ*, ...	,, 5 to 15 ,,
Fresh Extracts.	,, *Colchici*, ...	,, $\frac{1}{2}$ to 2 ,,
	,, *Colchici Aceticum*, . .	,, $\frac{1}{2}$ to 2 ,,
	,, *Taraxaci*, ...	,, 5 to 30 ,,

Fixed oils (*q.v.*) are also prepared by expression.

IV. The Extraction of Air-dry Vegetable Subtances by means of Solvents.—Among the more important groups of proximate constituents which have been found in the various organs of plants are :—

Essential, ethereal or volatile oils. Fixed oils, solid fats and waxes. Resins (oleo-resins, balsams, and gum-resins). Alkaloids. Acids, Inorganic and Organic— { usually as salts (in combination with mineral and vegetable bases—(alkaloids). Tannins. Glucosides. Neutral Principles (often bitter) and colouring matters.	Drugs containing one or more of these yield, to solvents, extractive regarded as so-called *active* matter. Best typical solvent :—alcohol, sp. gr. ·838.
Sugars. Albuminous substances and Ferments.[1] Gums, and mucilaginous substances. Starch, and amylaceous substances. Cellulose and Lignin (insoluble fibrous material). Mineral salts (of potash, soda, lime, magnesia, iron, manganese combined with silica, phosphoric and sulphuric acids, chlorine, &c. Moisture (Water).	Yield extractive usually regarded as so-called *inert* matter (for the most part insoluble in alcohol of above strength). Best typical solvent :—water.

Vegetable products, being consequently of a very heterogeneous composition, are only partially soluble in the various liquids (menstrua), generally used in their extraction.

The **solvents** or menstrua of chief pharmaceutical importance are :—

(1) *Ether* (*Æther*, B.P.) used in the preparation of the following :—Ext.[2] Stramonii ; Ext. Filicis Liquidum ; Oleo-resina Cubebæ ; Ext. Mezerei ; Liq. Epispasticus (*acetic ether*).

(2) Ethylic alcohol of varying strengths, *e.g.* (*a*) *rectified spirit*,

[1] Papain, an active ferment obtained from *Carica Papaya*, appears to be a notable exception ; as also Pepsin and others, from the animal kingdom.

[2] "*Extracta*," or *Extracts*, are preparations intended to represent the active constituents of vegetable drugs in a concentrated form. The operation of isolating the more soluble active matters from the inert insoluble fibrous material of crude organic products by means of solvents is termed "extraction," such impregnated solutions being termed "extracts." The pharmacopœial extracts are, however, the more concentrated products obtained by the evaporation of the above solutions, the terms *liquid*, *dry* and *soft*, being applied according to the consistence to which such products are thus reduced; and *aqueous*, *alcoholic*, *ethereal*, *acetic*, according to the solvent used. *Abstracts* are alcoholic extracts of drugs so diluted with milk-sugar that one part by weight of the finished product represents two parts of the drug ; they are dry light-brown "powders," official in the United States Pharmacopœia. The *Saccharures* of the French are similar preparations.

sp. gr. ·838 (84 per cent. alcohol by weight); (*b*) *proof spirit*, sp. gr. ·920 (49 per cent. alcohol), used chiefly in preparing the class of preparations known as "tinctures;" (*c*) *sherry wine* (containing about 16 to 18 per cent. alcohol), used for the "Vina" or pharmacopœial wines.

(3) Alcoholic solution of ammonia (*Spiritus Ammonia Aromaticus*), used in the preparation of Tinctura Guaiaci Ammoniata and Tinctura Valerianæ Ammoniata as a special solvent for the resinous principles (*cf.* Resins).

(4) A mixture of alcohol and ether (*Spiritus Ætheris*), used in the preparation of Tinctura Lobeliæ Æthera.

(5) *Water*, either hot or cold, used notably in the "Infusions," "Decoctions," "Extracts," and numerous other preparations; *water with acetic acid* used in the preparation of Acetum Cantharidis, Acetum Scillæ, Extractum Colchici Aceticum, and Vinum Ipecacuanhæ; *water with hydrochloric acid*, used in Ext. Cinchonæ Liquidum.

Rectified spirit is a solvent capable of extracting from vegetable substances—aromatic volatile oils, resins, tannins, organic acids and colouring-matters, alkaloids, glucosides, and certain proportions of fixed oils, leaving behind (undissolved) what in many instances is regarded as inert, viz., gummy and albuminous matters, mineral salts, including the totally insoluble fibre and tissues.

Water, on the other hand, exerts a feeble solvent action upon oleaginous and resinous active principles; while certain alkaloidal salts, glucosides, acids, most gums, and vegetable albumen it readily dissolves. The insolubility in these menstrua of the substances just enumerated, rather than being absolute, is, however, merely relative, for a certain proportion of rectified spirit may be added to an aqueous solution of gum or vegetable albumen without entirely precipitating it; and, *vice versâ*, a certain proportion of water may be added to alcoholic solutions of resins and oils without rendering them turbid. Upon this account, diluted alcohol (proof spirit), as yielding a more representative preparation, constitutes an important menstruum in the extraction of many of the pharmacopœial vegetable substances, where the composition of the drug to be exhausted, as by its freedom from resin, &c., does not point to the absolute necessity of using rectified spirit. Tinctures prepared with rectified spirit generally assume a milky appearance by the addition of water, owing to resinous substances being precipitated,[1] upon which account, when prescribed in mixtures, mucilage of acacia is frequently ordered

[1] *Podophylli Resina* is, indeed, prepared by exhausting the rhizome with rectified spirit, distilling off the greater portion of the spirit, and pouring the residual concentrated spiritous solution into three volumes of water, thus

in conjunction with them for their suspension; proof spirit tinctures, on the other hand, generally remain clear when mixed with water.

Maceration.—By this term is signified the placing of coarsely powdered solid matters of organic origin in contact with liquids in the *cold*, whereby the solution of some portion of the active principles soluble in the menstruum used, may be effected. It differs from the processes of infusion and digestion in that no heat is employed, and in its being continued for a longer time; it should be borne in mind, however, that two of the pharmacopœial infusions are prepared by maceration (with cold water), viz., *quassia* and *calumba.*

When liquids thus impregnated with extractive matter are concentrated by evaporation to a syrupy consistence, they constitute what are termed liquid extracts;[1] if further inspissated by evaporation, they yield "soft extracts," or when evaporated to dryness, "dry extracts" (*e.g.*, Ext. Aloes).

The Nycthemerum Process.—Under the extraction of essential oils from drugs by distillation with water (p. 48), in the example there given, it is stated that the drug was previously macerated in cold water for about twenty-four hours, such permeation with the solvent facilitating the solution and subsequent distillation of the oil. This process of maceration of drugs for a "night and a day" preliminary to distillation, constitutes what was formerly termed the "nycthemerum process"; it may probably with advantage be extended to the operation of distilling oils from other crude material, whether fresh or air-dry; these remarks consequently apply in the latter instance to the preparation of the medicinal distilled waters, *e.g.*, *Aqua Anethi*, *Aq. Anisi*, &c.

The following nineteen tinctures are prepared by maceration:—the process being to "macerate the ingredients with the menstruum for seven days in a closed vessel, with occasional agitation; strain, press, and filter; then add more menstruum to make the volume up to one pint." This process is carried out by introducing the ingredients into a wide-mouthed stoppered vessel, pour-

precipitating the resin. The two other pharmacopœial extracted resins (*jalap* and *scammony*) are prepared by a process very similar (*cf. Brit. Pharm.*).

[1] When water has been used as the solvent or menstruum, rectified spirit is generally directed to be added to such syrupy liquid when cold, not only to precipitate (coagulate) inert albuminous and gummy material (to be removed by filtration), but to preserve the product. When, in the preparation of extracts, spirit or ether has been used as a *menstruum*, the latter, instead of being dissipated by evaporation, is directed on grounds of economy to be recovered by distillation.

ing on the menstruum, inserting the stopper, and agitating from time to time during the period specified, the latter being very

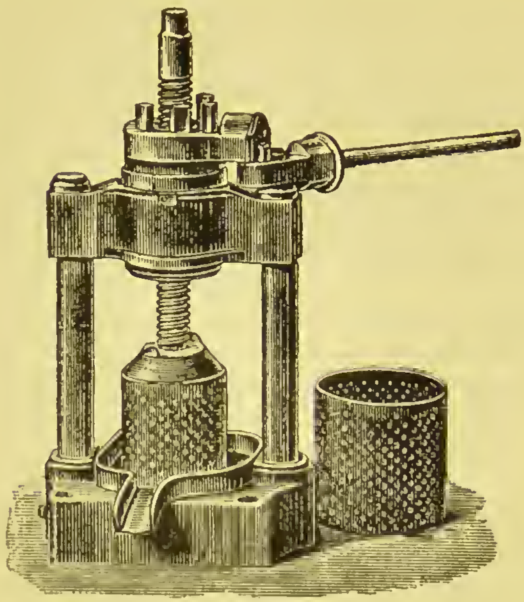


FIG. 59.—A press suitable for pressing tincture residues, fixed oils, and fresh juices.

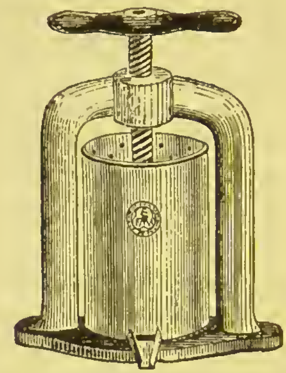


FIG. 60.—A small tincture press.

essential for efficient extraction. Those marked with an asterisk are prepared with rectified spirit, the rest with proof spirit.

Tinctures prepared by Maceration.

	Proportion of Active Ingredient.	Dose.
Tinctura Aurantii,	1 in 10	1 to 2 drm.
,, ,, *Recentis,**.	3 in 10	1 to 2 drm.
,, *Cantharidis,*	1 in 80	5 to 20 min.
,, *Catechu,*	1 in 8	½ to 2 drm.
,, *Cocci,*	1 in 8	
,, *Lavandulæ Compositæ,**.	1 in 213	½ to 2 drm.
,, *Limonis,*	1 in 8	½ to 2 drm.
,, *Lobeliæ Ætherea,** [1]	1 in 8	10 min. to ½ drm.
,, *Opii,*	1 in 13⅓	5 to 40 min.
,, ,, *Ammoniata,** (Liq. Amm. Ft.)	1 gr. in 96 min.	½ to 1 drm.
,, *Quassiæ,*	1 in 27	½ to 2 drm.
,, *Valerianæ Ammoniata,* [2]	1 in 8	½ to 1 drm.

[1] Menstruum :—*Sp. Ætheris.* [2] Menstruum :—*Sp. Ammon. Aromat.*

Tinctures prepared by Maceration—continued.

	Proportion of Active Ingredient.	Dose.
The following are not pressed:—		
Tinctura Aloes, ...	1 in 40 (complex)	1 to 2 drm.
,, *Asafœtidæ,** . . .	1 in 8	½ to 1 drm.
,, *Benzoini Composita,** . .	1 in 10	½ to 1 drm.
,, *Camphoræ Composita,* . .	¾ in 240	15 min. to 1 drm.
,, *Kino* * (water and glycerine),	1 in 10	½ to 2 drm.
,, *Tolutana,**	1 in 8	20 to 40 min.
,, *Guaiaci Ammoniata,*[1] . .	1 in 5	½ to 1 drm.

The student should observe that among the foregoing there are tinctures of a complex nature, although they are not designated "compound" (Co.), viz.:—

	Ingredients in 1 Pint.	Strength.	Dose.
Tinctura Aloes, .	½ oz. Socotrine aloes, 1½ oz. extract of liquorice, proof spirit	1 in 40	1 to 2 dr.
,, *Catechu,* .	2½ oz. catechu, 1 oz. cinnamon, proof spirit	1 in 8	½ to 2 dr.
,, *Kino,* .	2 oz. gum kino, 3 oz. glycerine, 5 oz. water, 12 oz. rectified spirit	1 in 10	½ to 2 dr.
,, *Opii Ammoniata,*	100 grains of opium, 180 grains each saffron and benzoic acid, 1 dr. oil of anise, 4 oz. strong solution of ammonia; rectified spirit	1 in 96	½ to 1 dr.
	Compound Tinctures.		
Tinctura Benzoini Co.	2 oz. benzoin, 1½ oz. storax, ½ oz. tolu, 160 grains Socotrine aloes, rectified spirit	1 in 10	½ to 1 dr.
,, *Camphoræ Co.*	40 grns. opium, 40 grns. benzoic acid, 30 grns. camphor, ½ drm. oil of anise, proof spirit	1 in 320 (1 in 240 in opium)	¼ to 1 dr.
,, *Lavandulæ Co.*	45 minims oil of lavender, 5 minims oil of rosemary, 75 grains each cinnamon and nutmeg, 150 grains red sandal wood, rectified spirit	1 in 213	½ to 2 dr.

[1] Menstruum:—*Sp. Ammon. Aromat.*

The drugs in the following are also extracted by maceration (for details, *cf. Brit. Pharmacopœia*) :—

With *Rectified Spirit.* Ext. Cannabis Indicæ.
,, ,, ,, and subsequent remaceration of resulting extract in ether. Ext. Mezerei.
,, ,, ,, afterwards with water (in succession). Ext. Jalapæ.
,, ,, ,, and subsequent decoction. Ext. Lupuli.
With *Proof Spirit.* Ext. Calumbæ; Ext. Colocynth. Co.
,, ,, ,, afterwards with water. Ext. Tarax. Liq.
With *Cold Water.* Ext. Glycyrrhizæ; E. Opii.
,, ,, ,, and coagulation with rectified spirit. Liquid extracts of Bael, Opium, Liquorice, and Ergot.
With "*Dilute Acetic Acid.*" Acetum Scillæ.[1]
With *Orange or Sherry Wine*, the pharmacopœial "Vina."

Vina, or **Wines**.—Practically attenuated tinctures—five are prepared by maceration.

	Composition.	Strength.	Dose.
Vinum Aloës, .	Socotrine aloes, cardamoms, ginger, and sherry	$\frac{3}{4}$ oz. to 1 pt.	1 to 2 drs.
,, *Antimoniale* (by solution),	Tartar emetic and sherry	2 grs. to 1 oz.	5 to 60 m.
,, *Aurantii* (by fermentation),	. . . . .	12 per cent. (alcohol)	...
,, *Colchici*, .	4 oz. dried corm and 1 pint sherry	1 in 5	10 to 30 m.
,, *Ferri*, .	1 oz. iron wire and 20 ozs. sherry	variable	1 to 4 drs.
,, *Ferri Citratis* (by solution),	Citrate of iron and ammonium, orange wine	1 gr. in 1 dr.	1 to 4 drs.
,, *Ipecacuanhæ* (by macer. and perc.),	Ipecacuanha, acetic acid, distilled water, and sherry	22 grs. to 1 oz.	$\frac{1}{2}$ to 6 drs.
,, *Opii*, .	Extract of opium, cinnamon, cloves, and sherry	22 grs. to 1 oz.	10 to 40 m.
,, *Quininæ* (by solution),	Sulphate of quinine, citric acid, and orange wine	1 gr. to 1 oz.	$\frac{1}{2}$ to 1 oz.
,, *Rhei*, .	Rhubarb root, canella bark, and sherry	33 grs. to 1 oz.	1 to 2 drs.
,, *Xericum* . (Sherry),	. . . . .	17 per cent. (alcohol)	...

[1] *Aceta* or Vinegars.—The use of vinegar as a medicinal solvent of the active constituents of drugs dates from a very remote period; "dilute acetic acid" is now substituted for vinegar as a menstruum in this class of preparations. There are now only two pharmacopœial vinegars—*Acetum Cantharidis* and *A. Scillæ.* A mixture of the stronger acids, "A. Aceticum Glaciale" and "A. Aceticum," is used in the preparation of the former.

Digestion differs from maceration only in the activity of the menstruum being promoted by some gentle application of heat (about 120° F.), sustained throughout the operation; ex., *with water*, Charta Epispastica, Dec. Sarsæ, Dec. Sarsæ Co., Syr. Sennæ. *With Acetic Acid*, Acetum Cantharidis. *With Rectified Spirit*, Resins of Scammony and Jalap.

Infusion.—This process consists in simply pouring the menstruum, consisting generally of boiling distilled water, upon the drug to be extracted, covering it up closely, agitating from time to time while cooling, and after the prescribed lapse of time (varying from 15 minutes to half an hour), straining off the liquid —the latter constituting the infusion.

Infusions of Chiretta and Cusparia are, however, prepared with water at 120° F., since the products thus obtained are of a more palatable character than when water at higher temperatures is used. For the same reason infusion of quassia is prepared with cold water; the latter is likewise used for Calumba to prevent the solution of the starch which the drug contains.

Infusions are prepared in special apparatus termed "infusion pots"; the best form of vessel is that introduced by the late Mr Peter Squire (fig. 61), which answers well, if the proper sized pots are used "for the quantities ordered, so that the ingredients are held by the perforated basin in the upper part of the fluid and *under the surface*. The impregnated fluid becoming of greater density, falls to the bottom, thus exposing the ingredients constantly to the continued action of fresh unimpregnated fluid until the action ceases, and the soluble matter is most effectually extracted. When hot infusions are made, boiling water should be first poured into the pot to thoroughly warm it; this being thrown out, the ingredients are put into the colander, and the requisite quantity[1] of boiling water poured upon them.

FIG. 61.—Squire's infusion-pot.

"The annexed section (fig. 62) of the Infusion Pot will show its construction.

"Concentrated Infusions are very largely used by general practitioners and some chemists; although very convenient and economical, they have not the aroma of the freshly-made infusion.

"Infusions are very apt to change in hot weather, and several

[1] Conveniently computed by the use of "scales and weights."

means have been proposed to preserve them. Small bottles filled to the brim with recently-made infusion, and placed in a boiler with hay and water, are kept at the boiling point for five minutes, then tied with a bladder, or stoppered while hot. Infusions thus treated are preserved good for several weeks. Inf. Gentian Co., Inf. Aurant. Co., so treated, kept good for three months. Infusion of Senna, which would change in twelve hours in hot weather, will keep for several days perfectly good if one grain of nitre be dissolved in each ounce of the infusion" (Squire's *Companion to the British Pharmacopœia*, 13th edition, pp. 181, 182).

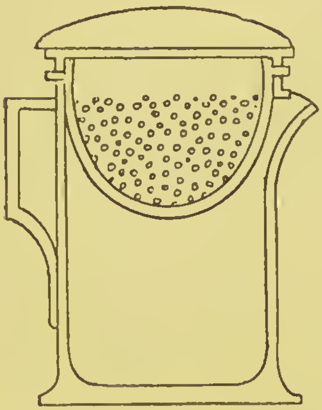


FIG. 62.—Section of infusion-pot.

Infusions should always be prepared fresh, as required, great attention being paid to the "time" allotted for extraction, since (as in preparing a cup of tea), if the time be unduly prolonged, much unintended objectionable matter may be likewise extracted, totally altering the character of the preparation. With the infusion-pot described, it is only necessary to bodily remove the colander with its contents at the lapse of time specified. Infusion of Kousso is ordered "not to be strained"; to those of Cinchona and Roses, a small quantity of dilute mineral acid is added to facilitate extraction, and, in the latter instance, to brighten its colour, and render the infusion more permanent (indeed, apart from the acid used, "alkalis" are incompatible with them).

A List of the Pharmacopœial Infusions.

	Proportions.	Directions.
Infusum Anthemidis, .	½ oz., water 10 oz.	Infuse ¼ hour and strain.
Inf. Aurantii (peel, cut small), ...	½ oz. , 10 ,,	,, ¼ ,, ,,
Inf. Aurantii Comp.— Bitter orange peel, cut small, ...	¼ oz.	
Fresh lemon peel, cut small, ...	56 grs. ,, 10 ,,	,, ¼ ,, ,,
Cloves (bruised), . .	28 grs.	
Inf. Buchu (leaves bruised), ...	½ oz., ,, 10 ,,	,, ½ ,, ,,
Inf. Calumbæ (cut small), ...	½ oz., cold ,, 10 ,,	,, ½ ,, ,,

A List of the Pharmacopœial Infusions—continued.

	Proportions.	Directions.
Inf. Caryophylli (bruised),	$\frac{1}{4}$ oz., water 10 oz.	Infuse $\frac{1}{2}$ hour and strain.
Inf. Cascarillæ (No. 20 powder), ...	1 oz., ,, 10 ,,	,, $\frac{1}{2}$,, ,,
Inf. Catechu (coarse powder), ... Cinnamon (bruised), . .	160 grs. 30 grs. } ,, 10 ,,	,, $\frac{1}{2}$,, ,,
Inf. Chiratæ (cut small), .	$\frac{1}{4}$ oz., 120° F. ,, 10 ,,	,, $\frac{1}{2}$,, ,,
Inf. Cinchonæ Acidum— Red Cinchona Bark in No. 40 powder, . . Aromatic Sulphuric Acid,	$\frac{1}{2}$ oz. 1 drm. } ,, 10 ,,	,, 1 ,, ,,
Inf. Cuspariæ (No. 40 powder), ...	$\frac{1}{2}$ oz., 120° F. ,, 10 ,,	,, 1 ,, ,,
Inf. Cusso (coarse powder),	$\frac{1}{4}$ oz., ,, 4 ,,	,, $\frac{1}{4}$ hr., not strained.
Inf. Digitalis (dried leaves),	28 grs., ,, 10 ,,	,, $\frac{1}{4}$ hour and strain.
Inf. Ergotæ (crushed), .	$\frac{1}{4}$ oz., ,, 10 ,,	,, $\frac{1}{2}$,, ,,
Inf. Gentianæ Comp. — Gentian Root (sliced), . Bitter orange peel (cut small), ... Fresh lemon peel (cut small), ...	55 grs. 55 grs. $\frac{1}{4}$ oz. } ,, 10 ,,	,, $\frac{1}{2}$,, ,,
Inf. Jaborandi (cut small),	$\frac{1}{2}$ oz., ,, 10 ,,	,, $\frac{1}{2}$,, ,,
Inf. Krameriæ (No. 40 powder), ...	$\frac{1}{4}$ oz., ,, 10 ,,	,, $\frac{1}{2}$,,
Inf. Lini (Linseed), . . Dried Liquorice root (No. 20 powder), . .	150 grs. 50 grs. } ,, 10 ,,	,, 2 ,, ,,
Inf. Lupuli, ...	$\frac{1}{2}$ oz., ,, 10 ,,	,, 1 ,, ,,
Inf. Maticæ (cut small),	$\frac{1}{2}$ oz., ,, 10 ,,	,, $\frac{1}{2}$,, ,,
Inf. Quassiæ (chips), . .	55 grs., cold ,, 10 ,,	,, $\frac{1}{2}$,, ,,
Inf. Rhei (sliced), . . .	$\frac{1}{4}$ oz., ,, 10 ,,	,, $\frac{1}{2}$,, ,,
Inf. Rosæ acidum (broken petals), ... Dil. Sulph. Acid, . .	$\frac{1}{2}$ oz. 1 drm. } ,, 10 ,,	,, $\frac{1}{2}$,, :
Inf. Senegæ (No. 20 powder), ...	$\frac{1}{2}$ oz., ,, 10 ,,	,, $\frac{1}{2}$,, ,,
Inf. Sennæ (Senna), . . Ginger (sliced), . . .	1 oz. 28 grs. } ,, 10 ,,	,, $\frac{1}{2}$,, ,,
Inf. Serpentariæ (No. 20 powder), ...	$\frac{1}{4}$ oz., ,, 10 ,,	,, $\frac{1}{2}$,, ,,
Inf. Uvæ-Ursi (bruised),	$\frac{1}{2}$ oz., ,, 10 ,,	,, 1 ,, ,,
Inf. Valerianæ (bruised),	$\frac{1}{4}$ oz., ,, 10 ,,	,, 1 ,, ,,

The process of infusion (*boiling water* being the menstruum) is involved also in the preparation of (*cf. Brit. Pharm.*) :—Ext. Aloës Barb.; Ext. Aloës Soc.; Ext. Papaveris; Syr. Papaveris; Syr. Hemidesmi; Syr. Rhœados; Syr. Rosæ Gallicæ.

With *olive-oil*—Ung. Cantharidis.

With *boiling lemon-juice*—Syr. Limonis.

The *Tisanes* of the French (1 of drug in about 150 of water) are similar preparations, but necessarily weaker in strength; they are prepared either by infusion, decoction, or maceration. *Apozèmes* differ from the above in being more concentrated.

Decoction is the term used to signify the operation of extracting a drug by ebullition with a solvent (generally water). It can only be employed with advantage for extracting principles which are non-volatile, from substances the texture of which is so dense and compact as to resist the less active methods of solution. The operation may be conducted in covered enamelled saucepans. Professor Redwood has alluded to this subject in the following terms:—

"The process of decoction or boiling, as a means of extracting the active constituents of drugs, is adopted as a preliminary operation in the preparation of some extracts, such as that of chamomile, and the liquid extracts of cascara sagrada and rhamnus frangula.

"But its more special application is in the production of the class of medicines called decoctions. The object to be aimed at in preparing these medicines is, that they should, as produced at different times, be as nearly uniform as possible in properties and appearance.

"The general official directions are, to 'boil for ten minutes in a covered vessel, then strain, and pour as much distilled water over the contents of the strainer as will make the strained product measure' a specified quantity.

"There are, however, several exceptions to this formula. The process for decoction of pomegranate root, for instance, is still constructed on what was the general formula for decoctions in the London Pharmacopœia; that is, to boil from two pints to one. So with reference to the compound decoction of aloes and decoction of sarsaparilla, these are deviations from the general type

"Some of the decoctions are popular and valuable medicines, and they deserve careful attention in their preparation. This is especially the case with regard to compound decoctions of aloes, and the decoctions of cinchona, pareira, and sarsaparilla. The decoctions of cinchona and pareira are among the most approved forms in which those valuable medicines are administered.

"Compound decoction of aloes, although still retained in this class, can hardly be said to be properly included among decoctions, for the process of boiling might without any disadvantage be entirely omitted in making it; but the name has been so thoroughly established, not only in the medical profession, but among the general public, that it would be long before it would be known under any other name.

"Decoction of cinchona is, no doubt, therapeutically, the most valuable of this class of preparations, and nearly allied to it in value is decoction of pareira. These are true decoctions, and may be taken as types of this class of preparations. In the production of each of these decoctions it is important that the vegetable substance should be sufficiently, but not too much, comminuted, and that it should then have its active constituents extracted as far as practicable by the solvent used. In both cases the vegetable substance is directed to be in No. 20 powder. This is the method now adopted in the Pharmacopœia for indicating a particular degree of disintegration, and if intelligently and properly carried out, it fulfils a good object; but if No. 20 powder consists of particles of all degrees of comminution, it may yield results that are not satisfactory.

"The two decoctions under notice are produced in very nearly the same way, but there are differences, and these deserve notice.

"The proportion of vegetable matter used in relation to the finished product is the same in both cases. The mode of operating is also the same in both cases, but while the cinchona is boiled for only ten minutes, the pareira is boiled for fifteen minutes. In fact, pareira is less easily thus exhausted than cinchona. Such at least was the conclusion arrived at by the committee appointed by the council of this Society. But there is a further difference than that I have noticed between the two processes. After boiling for the specified time, the pareira is at once strained, because what is taken up by the boiling water is retained after cooling. But not so with cinchona; this after the boiling, is allowed to cool before straining, because the boiling water takes up cinchotannates of the alkaloids, which are precipitated in the cooling of the decoction, and if then strained this precipitate is left with the bark residue in the strainer. The presence of the precipitate in the finished product used to be a cause of some difficulty in dispensing, some dispensers thinking it should be retained, and some that it should be rejected" (Prof. Redwood on "Galenic Pharmacy," *Pharm. Jour.*, vol. xvi. p. 1049).

All are simple preparations, with the exception of the decoctions of Aloes, Hæmatoxylon, and Sarsaparilla Co.

The Pharmacopœial Decoctions.

	Composition.	Strength.	Dose.
Decoctum Aloes Co., .	Extract of Socotrine aloes, ½ oz.; myrrh, saffron, and carbonate of potassium, of each ¼ oz.; extract of liquorice, 2 oz.; compound tincture of cardamoms, 15 oz.; water, *q.s.* to 50 oz. Boil all for five minutes, except the saffron and tincture, in 1 pint of water; add the saffron, and when cooled add the tincture two hours before straining, and make up to 50 oz. with water.	4·3 grains in 1 oz.	½ to 2 oz.
,, *Cetrariæ*, .	Washed Iceland moss, 1 oz., boiled for ten minutes in 1 pint of water, strained while hot, and made to measure 1 pint.	1 oz. to 1 pt.	1 to 4 oz.
,, *Cinchonæ*,	Powdered red bark, 1¼ oz.; boiled for ten minutes in 1 pint of water, strained when cold, and made to measure 1 pint.	1¼ oz. to 1 pt.	1 to 2 oz.

The Pharmacopœial Decoctions—continued.

	Composition.	Strength.	Dose.
Decoctum Granati radicis, .	Bark of pomegranate root, 2 oz.; boiled in water 40 oz., down to 1 pint.	2 oz. to 1 pt.	2 to 4 oz.
,, *Hæmatoxyli*	Logwood chips, 1 oz., and cinnamon, 55 grs.; boiled for ten minutes in 1 pint of water, and made to measure 1 pint.	1 oz. to 1 pt.	1 to 2 oz.
,, *Hordei*, .	Washed barley, 2 oz.; boiled in $1\frac{1}{2}$ pint of water for twenty minutes and strained. Product, about 1 pint.	2 oz. to 1 pt.	1 to 4 oz.
,, *Papaveris*,	Bruised poppy capsules, 2 oz.; boiled for ten minutes in $1\frac{1}{2}$ pint of water, and made to measure 1 pint.	2 oz. to 1 pt.	used externally.
,, *Pareiræ*, .	Pareira root, $1\frac{1}{4}$ oz.; boiled for fifteen minutes in 1 pint of water, and made to measure 1 pint.	$1\frac{1}{4}$ oz. to 1 pt.	1 to 2 oz.
,, *Quercus*, .	Oak bark, $1\frac{1}{4}$ oz.; boiled for ten minutes in 1 pint of water, and made to measure 1 pint.	$1\frac{1}{4}$ oz. to 1 pt.	used externally.
,, *Sarsæ*, .	Sarsaparilla, $2\frac{1}{2}$ oz., digested in $1\frac{1}{2}$ pint of boiling water for 1 hour, then boiled for ten minutes and made to measure 1 pint.	$2\frac{1}{2}$ oz. to 1 pt.	2 to 10 oz.
,, *Sarsæ Co.*,	Sarsaparilla, $2\frac{1}{2}$ oz.; sassafras root, guaiacum wood, and liquorice root, of each $\frac{1}{4}$ oz.; mezereon bark, $\frac{1}{8}$ oz.; boiling water, $1\frac{1}{2}$ pint; digested for one hour, then boiled for ten minutes and made to measure 1 pint.	$2\frac{1}{2}$ oz. to 1 pt.	2 to 10 oz.
,, *Scoparii*, .	Dried tops of broom, 1 oz., boiled for ten minutes in 1 pint of water, and made to measure 1 pint.	1 oz. to 1 pt.	2 to 4 oz.
,, *Taraxaci*,	Dried, sliced, and bruised dandelion root, 1 oz., boiled for ten minutes in 1 pint of water, strained, and made to measure I pint.	1 oz. to 1 pt.	2 to 4 oz.

As with infusions and tinctures, by the evaporation of the menstruum, an extract is left. The process of decoction is used in the preparation of the following :—Ext. Hæmatoxyli, Gentianæ, Pereiræ, Anthemidis, Cascaræ Sagradæ, Rhamnæ Frangulæ: the two latter, being liquid extracts, are clarified with rectified spirit. Syr. Tolutanus is also prepared by first boiling the balsam with water.

A List of the Extracts.

Extract.	Dose.	Extract.	Dose.
Ext. Aconiti, . . .	$\frac{1}{4}$ to 1 grain.	*Ext. Glycyrrhizæ*, .	5 gr. to 1 dr.
,, *Aloës Barb.*, .	2 ,, 6 ,,	,, ,, *Liq.*	1fl.dr.
,, ,, *Soc.*, . .	2 ,, 6 ,,	,, *Hæmatoxyli*, .	10 to 30 gr.
,, *Anthemidis*, .	2 ,, 10 ,,	,, *Hyoscyami*, .	5 ,, 10 ,,
,, *Belæ Liq.*, . .	1 ,, 2 fl. dr.	,, *Jaborandi*, . .	2 ,, 10 ,,
,, *Belladonnæ*, .	$\frac{1}{4}$,, 1 gr.	,, *Jalapæ*, . . .	5 ,, 15 ,,
,, ,, *Alcohol*,	$\frac{1}{16}$,, $\frac{1}{4}$,,	,, *Krameriæ*, . .	5 ,, 20 ,,
,, *Calumbæ*, . .	2 ,, 10 ,,	,, *Lactucæ*, . .	5 ,, 15 ,,
,, *Cannabis Ind.*,	$\frac{1}{4}$,, 1 ,,	,, *Lupuli*, . . .	5 ,, 15 ,,
,, *Cascaræ Sag.*, .	2 ,, 8 ,,	,, *Nucis Vom.*, .	$\frac{1}{4}$,, 1 ,,
,, ,, *Liq.*, .	$\frac{1}{2}$,, 2 fl.dr.	,, *Opii*, ...	$\frac{1}{2}$,, 2 ,,
,, *Cimicif. Liq.*, .	3 ,, 30 min.	,, ,, *Liq.*, . .	10 ,, 40 min.
,, *Cinchonæ Liq.*,	5 ,, 10 ,,	,, *Papaveris*, . .	2 ,, 5 gr.
,, *Cocæ Liq.*, . .	$\frac{1}{2}$,, 2 fl. dr.	,, *Pareiræ*, . .	10 ,, 30 ,,
,, *Colchici*, . .	$\frac{1}{2}$,, 2 gr.	,, ,, *Liq.*, .	$\frac{1}{2}$,, 2fl.dr.
,, ,, *Acet.*, .	$\frac{1}{2}$,, 2 ,,	,, *Physostig.*, . .	$\frac{1}{16}$,, $\frac{1}{4}$ gr.
,, *Colocynth Comp.*,	3 ,, 10 ,,	,, *Quassiæ*, . .	3 ,, 5 ,,
,, *Conii*, . . .	2 ,, 6 ,,	,, *Rhamni Frang.*	15 ,, 60 ,,
,, *Ergotæ Liq.*, .	10 ,, 30 min.	,, ,, ,, *Liq.*	1 ,, 4fl.dr.
,, *Filicis Liq.*, .	15 ,, 30 ,,	,, *Rhei*, . . .	5 ,, 15 gr.
,, *Gelsemii Al-*		,, *Sarsæ Liq.*, .	2 ,, 4fl.dr.
cohol, . . .	$\frac{1}{2}$,, 2 gr.	,, *Stramonii*, . .	$\frac{1}{4}$,, $\frac{1}{2}$ gr.
,, *Gentianæ*, . .	2 ,, 10 ,,	,, *Taraxaci*, . .	5 ,, 30 ,,

Percolation or Displacement (*per*, through; *colo*, to strain, soak).—Supposing that some powdered ginger, a substance containing matters freely soluble in alcohol, were packed in a cylindrical vessel open at each end (the lower extremity being tied over with a piece of muslin to prevent the powder from falling through), and that a column of alcohol were poured in upon the top at the upper extremity, it is evident that the liquid permeating the powdered mass would, in its downward journey, become impregnated with the soluble matter, and finally drip into the receiver placed below, yielding what is technically termed a *tincture* of ginger. It is also evident that, by the passage of a sufficient quantity of menstruum, the ginger would ultimately become exhausted of its constituents soluble in alcohol. This method of

extracting drugs, consisting as it does of the *displacement* of an impregnated menstruum by a superimposed column of the same solvent descending under the action of gravity is termed *percolation* (*vide Lixiviation*, p. 33).

In the British Pharmacopœia, the process of percolation is directed to be used in conjunction with maceration in the preparation of several tinctures, yielding when properly carried out very efficient preparations. The directions are as follows :—"Macerate the ingredients in three-fourths of the spirit in a closed vessel for forty-eight hours, agitating occasionally; then transfer to a percolator, and when the fluid ceases to pass, continue the percolation with the remaining fourth of the spirit. Afterwards subject the contents of the percolator to pressure, filter the product, mix the liquids, and add sufficient additional menstruum to make up to the requisite volume." No mention of *packing* being alluded to in the above process, it is evidently intended that the contents of the macerating jar be stirred up and transferred bodily to the percolator, allowing the dregs to pack themselves.

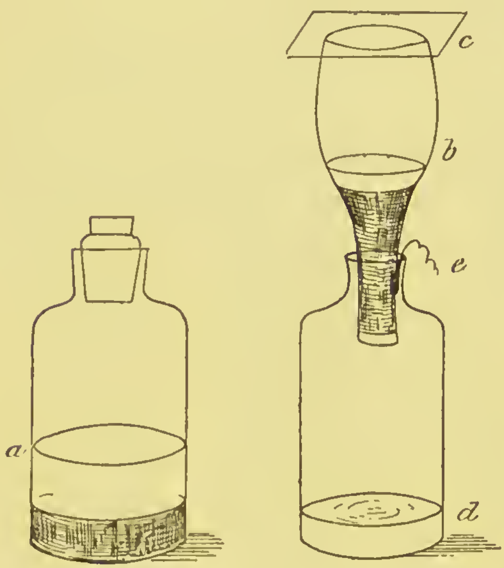


Fig. 63.—Percolation apparatus for production of one or two pints of tincture. *a*, Macerating vessel; *b*, percolator (a wine-bottle with the bottom ground off, the neck tied over with muslin; immediately over the latter a column of clean sand is placed, to the height of about ¾ inch); *c*, a piece of window-glass (not fitting air-tight); *d*, the percolate; *e*, a piece of string to prevent the percolator from fitting air-tight.

Squire gives the following directions for the percolation of tinctures :— "After the materials have been macerated for forty-eight hours in three-fourths of the menstruum ordered, percolation will be most efficiently performed by decanting the liquid, pressing the ingredients in the hand, and carefully packing them, in small portions at a time, in a conical percolator, so that the mass shall be uniformly tight throughout. The decanted liquid may then be poured upon the ingredients and allowed to percolate, the remainder of the menstruum being afterwards poured upon them in order to chase the strong tincture out. As soon as the liquid ceases to drop, the ingredients are to be removed and pressed. Any deficiency in this product may be made up by adding more of the menstruum and repeating the pressure" (*Companion to the British Pharmacopœia*).

The following forty-two pharmacopœial tinctures are prepared by **maceration and percolation combined.** Those marked with an asterisk are prepared with rectified spirit, the rest with proof spirit :—

Tincture.	Proportion of Active Ingredients.	Dose.
*Tinctura Aconiti,**	1 in 8	5 to 15 min.
,, *Arnicæ,**	1 in 20	½ to 1 drm.
,, *Belladonnæ* (leaves), . .	1 in 20	5 to 20 min.
,, *Buchu,*	1 in 8	1 to 2 drm.
,, *Calumbæ,*	1 in 8	½ to 2 drm.
,, *Capsici,**	1 in 27	10 to 20 min.
,, *Cardamomi Composita,* .	1 in 80	½ to 2 drm.
,, *Cascarillæ,*	1 in 8	½ to 2 drm.
,, *Chiratæ,*	1 in 8	½ to 2 drm.
,, *Cimicifugæ,*	1 in 8	15 to 60 min.
,, *Cinchonæ,*	1 in 5	½ to 2 drm.
,, *Cinchonæ Composita,* . .	1 in 10	½ to 2 drm.
,, *Cinnamomi,**	1 in 8	½ to 2 drm.
,, *Colchici Seminum,* . .	1 in 8	10 to 30 min.
,, *Conii* (fruit), ...	1 in 8	20 to 60 min.
,, *Croci,*	1 in 20	½ drm.
,, *Cubebæ,**	1 in 8	½ to 2 drm.
,, *Digitalis,*	1 in 8	10 to 30 min.
,, *Ergotæ,*	1 in 4	5 to 30 min.
,, *Gallæ,*	1 in 8	½ to 2 drm.
,, *Gelsemii,*	1 in 8	5 to 20 min.
,, *Gentianæ Composita,* . .	1 in 13⅓	½ to 2 drm.
,, *Hyoscyami,*	1 in 8	½ to 1 drm.
,, *Jaborandi,*	1 in 4	½ to 1 drm.
,, *Jalapæ,*	1 in 8	½ to 2 drm.
,, *Krameriæ,*	1 in 8	½ to 2 drm.
,, *Laricis,**	1 in 8	20 to 30 min.
,, *Lobeliæ,*	1 in 8	10 to 30 min.
,, *Lupuli,*	1 in 8	½ to 2 drm.
,, *Myrrhæ,**	1 in 8	½ to 1 drm.
,, *Pyrethri,**	1 in 5	...
,, *Rhei,*	1 in 10	4 to 8 drm.
,, *Sabinæ,*	1 in 8	20 to 60 min.
,, *Scillæ,*	1 in 8	10 to 30 min.
,, *Senegæ,*	1 in 8	½ to 2 drm.
,, *Sennæ,*	1 in 8	1 to 4 drm.
,, *Serpentariæ,*	1 in 8	½ to 2 drm.
,, *Stramonii,*	1 in 8	10 to 30 min.
,, *Sumbul,**	1 in 8	10 to 30 min.
,, *Valerianæ,*	1 in 8	1 to 2 drm.
,, *Veratri Viridis,** . . .	1 in 5	5 to 20 min.
,, *Zingiberis,**	1 in 8	15 to 60 min.

Of the foregoing the two following are "Complex."

Tinctura Rhei, .	2 oz. of root, ¼ oz. each of coriander fruit aud cardamoms and saffron (proof spirit).	1 in 10	1 to 8 drs.
,, *Sennæ*, .	2½ oz. of leaves, 2 oz. raisins, ½ oz. each of caraway and coriander (proof spirit).	1 in 8	1 to 4 drs
	Compound.		
,, *Cardamomi Co.*,	¼ oz. of seeds, ¼ oz. caraway, 2 oz. raisins, ½ oz. cinnamon, 55 grs. cochineal (proof spirit).	1 in 80	½ to 2 drs.
,, *Cinchonæ Co.*,	2 oz. of red bark, 1 oz. orange peel, ½ oz. serpentary, 55 grs. saffron, 28 grs. cochineal (proof spirit).	1 in 10	½ to 2 drs.
,, *Gentianæ Co.*,	1½ oz. of root, ⅜ oz. orange-peel, ¼ oz. cardamoms (proof spirit).	1 in 13⅓	½ to 2 drs.

For the remaining tinctures, *vide* p. 173.

The drugs in the following preparations are also extracted by **maceration and percolation** (cf. *Brit. Pharm.*):—

With rectified spirit—Linimentum Aconiti and Lin. Belladonnæ.
,, ,, ,, Ext. Cimicifugæ Liq., Ext. Nucis Vom.,[1] Ext. Physostig.
,, ,, ,, *percolation being continued with water*—Ext. Bellad. Alc., Ext. Gelsem. Alc.
With proof spirit—Ext. Cocæ Liq.
,, ,, ,, *percolation being continued with water*—Ext. Cascaræ Sagrad., Ext. Jaborandi., Ext. Rhamni Frang., Ext. Rhei, Ext. Sarsæ Liq.
With acetic acid, evaporation to dryness, and remaceration of residue in sherry wine—Vinum Ipecacuanhæ.
With cold water—Ext. Quassiæ.
,, ,, ,, (*mixed with hydrochloric acid and glycerine*)—Ext. Cinchonæ Liquidum.[2]

By percolation alone:—

With ether, and subsequent recovery of menstruum by distillation—Oleoresina Cubebæ, Ext. Filicis Liquidum.
,, ,, afterwards with *proof spirit* (the ethereal percolate being neglected)—Ext. Stramonii.

[1] Menstruum, a mixture of rectified spirit 4 parts, distilled water 1 part.
[2] HCl to convert the alkaloidal cinchotannates into soluble salts. Glycerine to prevent subsequent oxidation of proximate constituents, thereby yielding a clear instead of turbid solution when the extract is dispensed with aqueous vehicles.

With rectified spirit—Tinctura Zingiberis Fortior.
With spirit and water—Syr. Rhei.
With cold water—Ext. Krameriæ.
With boiling water (*after previous infusion*)—Syrupus Papaveris, Ext. Papaveris.
With acetic acid (*after previous digestion*)—Acetum Cantharidis.

Additional remarks on Percolation.—The following directions have been given in the U.S. Pharmacopœia :—

"The kind of filtration, known as *percolation* or the *process of displacement*, directed in this Pharmacopœia, consists in subjecting a substance or substances, in powder, contained in a vessel called a *percolator*, to the solvent action of successive portions of a menstruum in such a manner that the liquid, as it traverses the powder in its descent to the recipient, shall become charged with the soluble portion of it, and pass from the percolator free from insoluble matter.

"When the process is successfully conducted, the first portion of the filtered liquid, or *percolate*, will be nearly saturated with the soluble constituents of the substance treated ; and, if the quantity of menstruum be sufficient for its exhaustion, the last portion will be nearly destitute of colour, odour, and taste.

"The percolator should be either conical, or nearly cylindrical with a conical termination at the smaller end, and provided internally with a porous or colander-like partition or diaphragm, resting transversely immediately above its neck for the support of the powder. Ordinary glass funnels, varying in capacity from one to eight pints, are to be preferred for most of the operations requiring percolation in this Pharmacopœia ; but percolators may also be made of earthenware or tinned iron, especially of the latter when required of large size. Tinned iron, however, should not be used when the liquid acts chemically on the material. When a funnel is used, a circular piece of muslin or lint pressed into the neck by means of a cork with notched sides forms a good diaphragm ; but in all cases a similar piece of muslin, moistened slightly with the menstruum, should be interposed between the diaphragm and the powder to prevent the passage of the fine particles of the latter.

"The substance to be subjected to percolation, after having been reduced by sifting to a uniform powder, of the fineness indicated in the formula, is to be put into a basin with from one-fourth to one-half of its weight of the menstruum, and the two rubbed together until the powder is uniformly moistened.

"A portion of the powder is now to be carefully placed upon the diaphragm, prepared as above directed, and pressed gently until the muslin, resting against the sides of the percolator just above the neck, is covered with a uniform layer. The remainder of the powder is to be then transferred to the percolator, and compressed evenly and firmly, and the levelled surface covered with a circular piece of moistened muslin, so that the liquid poured upon it may penetrate equably and not disarrange the powder.

"The percolator being now properly supported, with its neck in a bottle previously marked for the quantity or quantities of liquid to be percolated, the menstruum is to be poured on the muslin until the space above is nearly filled ; and a layer of it must be constantly maintained above the powder so as to prevent the access of air to its interstices, until all has been added, or until the requisite quantity of percolate has been obtained.

"If the fineness of the powder and its arrangement in the percolator have

been properly attended to, the percolate will pass out, by drops, with greater or less rapidity, according to the size of the percolator; but if, by reason of accidental imperfection in the powder or in the packing, the liquid pass more rapidly than this, the neck of the percolator should be obstructed by means of a cork until the required slowness has been obtained.

"When the dregs of a tincture are to be subjected to percolation after maceration with all the menstruum, the liquid portion should be drained off, the solid portion packed in a percolator as before described, and the liquid gradually poured on until all has passed the surface, when, immediately, sufficient of the original menstruum should be poured on to displace the absorbed liquid until the prescribed quantity of the tincture has been obtained."

Various forms of percolators have from time to time been constructed and described, some for the purpose of carrying on the maceration and percolation in the same vessel. Of the latter denomination the following apparatus is known as the York Glass Company's form of apparatus (fig. 64). Fig. 65 shows the process

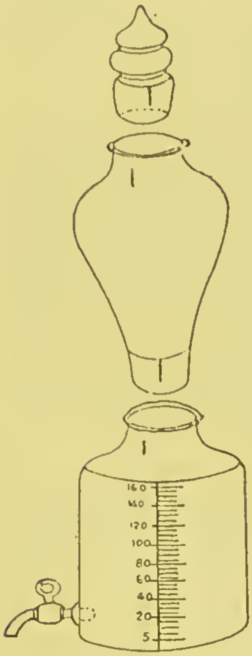


Fig. 64.—The York Glass Company's apparatus for maceration and percolation.

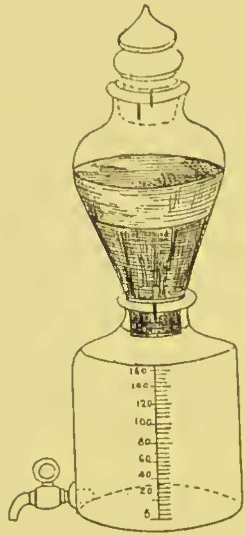


Fig. 65.—Process of maceration.

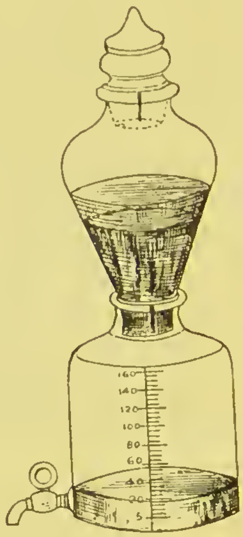


Fig. 66.—Process of percolation.

of maceration, the ingredients in the percolator being retained in their position by the position of the "grooves" at its apex and base; that is, the stopper at apex being air-tight, percolation cannot proceed, and if it were taken out altogether it could not proceed since there is no egress for the air in the receiver. Fig. 66

shows the process of percolation; the stopper has been twisted round till its groove coincided with the groove in the neck of the percolator, and the body of the percolator has been twisted until its groove has coincided with the groove in the neck of the receiver—in other words, both percolator and receiver are then in communication with the air, and the liquid commences to drip by its own gravity.

The arguments for and against the use of percolation for the preparation of tinctures have been summarised by Professor Redwood as follows :—

"*In its favour we have*—

"1. Economy of time. A tincture may be thus prepared in a few hours, which by maceration would require a week.

"2. Excellence of product. Some tinctures are considered to be better when made by this process than by lengthened maceration, because in the latter case a change may be effected in some of the soluble constituents of the solution first formed when this is left in contact with the insoluble residue of the vegetable substance.

"3. Concentrated state of the product. The process is well suited for getting highly concentrated tinctures.

"4. Recovery of the valuable part of the product. This is more completely effected by this process than it can be by maceration and expression.

"*On the other hand it may be urged against the process*—

"1. That it requires skill and knowledge for its successful application, which can only be acquired by much experience ; whereas, in making tinctures by maceration, unskilled labour, such as that of apprentices, can be applied.

"2. That although the time involved in making a tincture by percolation is comparatively short, yet the attention of the operator is more continuously required than it is in the case of maceration.

"3. That although a larger proportion of the strong tincture is recovered by percolation and displacement than by maceration and expression, yet in the former case, when legitimately conducted, the last part of the tincture is only recovered at the cost of an equal volume of spirit which is used for displacement.

"4. That to obviate the loss of spirit used for displacement, there is a strong inducement to the use of water, and water is sometimes used as a displacing liquid, which necessarily alters and injures the product. That water cannot be properly so used may be demonstrated by a simple experiment. I have here a glass tube with two bulbs blown in it. The lower bulb and part of the tube are filled with colourless water, whilst the upper bulb and part of the tube contain spirit coloured with magenta. They may be thus kept, with the spirit above the water, for many days, or even weeks, without any appreciable amount of admixture taking place; but if we reverse the arrangement, and place the water above the spirit, as would be done in using water to displace spirit in a percolator, complete admixture of the two liquids will take place in a few minutes."

V. The Isolation of the Volatile constituents of Vegetable Substances by the Application of Heat.

(*a*) *By distillation with water.* (See *Essential Oils.*)

Aquæ.—Medicated, aromatic, or distilled waters are aqueous solutions impregnated with some volatile aromatic substance, usually obtained by distilling the drug with water. The following are thus obtained :[1]—

Aqua Anisi, 1 lb. to a gallon product.	*Aqua Fœniculi*, 1 lb. to a gallon product.
,, *Anethi*, ,, ,,	,, *Pimentæ*, 14 oz. ,, ,,
,, *Carui*, ,, ,,	,, *Rosæ*, 10 lbs. ,, ,,
,, *Cinnamomi*, 20 oz. ,,	,, *Sambuci*, 10 lbs. ,, ,,

Prepared by distilling the essential oil of the drug with water :—

Aq. Menthæ Piperitæ, 1½ drachms to the gallon.
,, *Menthæ Viridis*, ,, ,, ,,

Miscellaneous :—

Aqua Aurantii Floris.—Distilled from fresh flowers. (Imported.)
,, *Camphoræ.*—A solution of camphor in water, ½ gr. to 1 oz. nearly.
,, *Chloroformi.*—A solution of 1 dr. of chloroform in 25 oz. of water.
,, *Laurocerasi.*—A pint distilled from 1 lb. chopped fresh leaves and 2½ pints of water; standardised to contain ·1 per cent. hydrocyanic acid.

The doses of all the waters range from 1 to 2 oz. (except Aq. Laurocerasi, ½ to 2 drms.); they are generally used as vehicles or diluents (except Aq. Laurocerasi) in prescribing other more potent medicines in the form of mixtures.

(*b*) *By distillation with water and fixed caustic alkali* (*e.g.*, potash, to liberate the weaker base from the alkaloidal salt). The isolation of volatile alkaloids—conine, nicotine, and sparteine [non-pharmacopœial].

(*c*) *By distillation with rectified spirit and strong solution of Ammonia.*—Spiritus Ammoniæ Aromaticus; Spiritus Ammoniæ Fœtidus.

By distillation with proof spirit.—Spiritus Armoraciæ Compositus.

(*d*) *By sublimation* (*q.v.*).—Acid Benzoicum, the purification of Camphor.

[1] If much larger proportions of the drug were directed to be used, the distillate would necessarily become superimpregnated, with separation of oil on the surface. Medicinal waters, when recently distilled, are, as a rule, harsh, unfit for use, and destitute of their peculiarly characteristic aroma; which latter is only developed and at its maximum after some months' maturing: to effect this, they must not be kept in closely stoppered vessels but only in such a manner as to keep out dust. (See *Essential Oils.*)

VI. The Admixture of previously elaborated Chemical and Galenical Substances.

The following preparations admit of no satisfactory classification. The majority, however, will be found to belong to the above broad group, and many to one or other of the following classes :—

(*a*) *The admixture of solutions, e.g.*, the dilute acids, essences, spirits, tinctures of acetate and the perchloride of iron, syrups of orange and ginger, &c.

(*b*) *The admixture of liquids and soluble substances, e.g.*, the collodions, glycerines, liquid extract of pareira, the two tinctures of quinine, tinctures of cannabis indica, iodine, podophyllum and nux vomica, spirit of camphor, and the majority of the syrups.

(*c*) *The admixture of substances to produce a semisolid, e.g.*, the poultices, confections.

(*d*) *To produce a firm plastic mass, e.g.*, the pills and lozenges (the latter afterwards dried).

(*e*) *Of dry impalpable powders, e.g.*, "pulveres."

Further classification will suggest itself to the student.

Acida Diluta, or the Dilute Acids.—The concentrated commercial acids so diluted with water as to facilitate the regulation and accurate measurement of their doses.

		Strength.
Acidum Aceticum Dilutum,		1 in 8
,, *Hydrochloricum Dilutum*,		1 in $3\frac{1}{4}$
,, *Lacticum* ,,		1 in $6\frac{2}{3}$
,, *Nitricum* ,,		1 in 5
,, *Nitrohydrochloricum Dilutum*,	HCl.	1 in 8
	HNO_3.	1 in 11
,, *Phosphoricum* ,,		1 in $6\frac{2}{3}$
,, *Sulphuricum* ,,		1 in 12
,, ,, *Aromaticum*,		1 in 14

Of the above, *Acidum Sulphuricum Aromaticum* is the only truly galenical preparation (cf. *Brit. Pharm.*). There are two other dilute acids, viz., *Ac. Hydrobrom. Dil.* and *Ac. Hydrocyan. Dil.*, prepared directly by distillation, and standardisation of the products; together with the above, the dilute acids are definite chemical products. The dose of each is practically 10 to 30 minims; that of *hydrocyanic acid* is 2 to 8 minims.

Cataplasmata, or Poultices.—External applications of a pasty consistence generally applied warm. Linseed-meal is their basis (*C. Fermenti* excepted).

Cataplasma Carbonis, . .	Wood charcoal, ½ oz.; bread crumb, 2 oz.; linseed-meal, 1½ oz.; boiling water, 10 oz. —1 in 28.
,, *Conii*, . .	Hemlock juice, 1 oz.; linseed-meal, 4 oz.; boiling water, 10 oz.—1 in 15.
,, *Fermenti*, . .	Beer yeast, 6 oz.; wheaten-flour, 14 oz.; water at 100° F., 6 oz.—1 in 4⅓.
,, *Lini*, . .	Linseed-meal, 4 oz.; boiling water, 10 oz.—1 in 3½.
,, *Sinapis*, . .	Mustard, 2½ oz.; linseed-meal, 2½ oz.; boiling water, 10 oz.—1 in 6.
,, *Sodæ Chlorinatæ*,	Solution of chlorinated soda, 2 oz.; linseed-meal, 4 oz.; boiling water, 8 oz.—1 in 7.

Chartæ, or Medicated Papers.—Cartridge-paper coated with an active vesicating compound used as a plaster :—

Charta Epispastica.—White wax, 4 oz.; spermaceti, 1½ oz.; olive-oil, 2 oz.; resin, ⅞ oz.; cantharides, 1 oz.; water, 6 oz.; digested in a water-bath for two hours. Reject the watery portion, add canada balsam, ¼ oz., and spread on slips of paper.

Charta Sinapis.—Paper smeared with mustard in powder, 1 oz.; mixed with solution of gutta percha, 2 oz. To be dipped in tepid water before use, to develop the active principle.

Collodia, or Collodions.—Solutions of pyroxylin in ether and spirit ; upon application, a protective film is formed owing to the rapid volatilisation of the solvent.

Collodium, . . .	Pyroxylin 1, ether 36, spirit 12.
,, *Flexile*, .	Collodion 48, canada balsam 2, castor-oil 1.
,, *Vesicans*,	Pyroxylin 1, dissolved in 20 of *Liq. Epispast.*

Confectiones, or Confections.—Composed essentially of medicinal powders incorporated into a paste with syrups, of such consistence that they are neither too stiff to be swallowed, nor so thin as to allow the powders to separate. The two confections of *Roses* are used chiefly as good general excipients for pill-masses. Dose of each, about 2 drams.

	Composition.	Strength.
Confectio Opii, . .	Compound powder of opium 1 part, syrup 3 parts.	1 in 40 (opium)
,, *Piperis*, . .	Powdered black pepper 2, powdered caraway fruit 3, honey 15.	1 in 10
,, *Rosæ Caninæ*, .	Hips, free from seeds, 1, beaten, sifted, and added to sugar 2.	1 in 3
,, *Rosæ gallicæ*, .	Fresh red rose petals 1, beaten with sugar, 3.	1 in 4
,, *Scammonii*, .	Scammony resin 48, ginger 24, oil of caraway 2, oil of cloves 1, syrup 48, honey 24 ; add the oils last.	1 in 3
,, *Sennæ*, . .	Powdered senna, 7 oz.; powdered coriander, 3 oz.; figs, 12 oz.; tamarind, 9 oz.; cassia pulp, 9 oz.; prunes, 6 oz.; extract of liquorice, 1 oz.; sugar, 30 oz.; water, *q.s.* to 75 oz. Boil the figs and prunes in 24 oz. water for 4 hours ; in this digest the cassia and tamarind for 2 hours, add sugar and liquorice to strained pulp, dissolve, add the senna and coriander.	1 in 11
,, *Sulphuris*, .	Sulphur, 4 oz.; cream of tartar, 1 oz.; syrup of orange peel, 4 fl. oz.; tragacanth, 18 grs.	1 in $2\frac{1}{2}$
,, *Terebinthinæ*, .	Oil of turpentine, 1 oz.; powdered liquorice, 1 oz.; honey, 2 oz.	1 in 4

Emplastra, or Plasters.—Solid compositions of resin, wax, and fatty substances, associated with active medicinal substances, for external application.

	Substances used in the Preparation.	Strength.
Emplastrum Ammoniaci cum Hydrargyro,	Ammoniacum, mercury, olive-oil, and sublimed sulphur.	1 of Hg in 5
,, *Belladonnæ*, .	Alcoholic extract of Belladonna, resin plaster, soap plaster.	1 in 5
,, *Calefaciens*, .	Cantharides, expressed oil of nutmeg, yellow wax, resin, resin plaster, soap plaster, boiling water.	1 in 24 of Cantharides
,, *Cantharidis*, .	Cantharides, yellow wax, suet, lard, resin.	1 in 3
,, *Ferri*, . . .	Peroxide of iron, Burgundy pitch, lead plaster.	1 in 11

	Substances used in the Preparation.	Strength.
Emplastrum Galbani, . .	Galbanum, yellow wax, ammoniacum, lead plaster.	1 in 11
,, *Hydrargyri*, .	Mercury, olive-oil, sulphur, lead plaster.	1 in 3
,, *Opii*, . . .	Powdered opium, resin plaster.	1 in 10
,, *Picis*, . . .	Burgundy pitch, frankincense, resin, yellow wax, expressed oil of nutmeg, olive-oil, water.	1 in 2
,, *Plumbi*, . .	Oxide of lead, olive-oil, water (oleate of lead, with a little glycerine).	
,, *Plumbi Iodidi*, .	Iodide of lead, lead plaster, resin.	1 in 10
,, *Resinæ*, . .	Resin, lead plaster, and curd soap.	1 in 9½
,, *Saponis*, . .	Curd soap, lead plaster, resin.	1 in 7
,, *Saponis Fuscum*,	Curd soap, yellow wax, olive-oil, oxide of lead, vinegar.	1 in 6

Enemata, or Clysters.—Preparations for injecting into the rectum.

	Active Constituents.	Vehicle.
Enema Aloës, . .	Aloes, 40 grs.; carbonate of potassium, 15 grs.	Starch mucilage, 10 oz.
,, *Magnesii Sulphatis*, .	Sulphate of magnesium, 1 oz.; olive-oil, 1 oz.	,, ,, 15 oz.
,, *Opii*, . .	Tincture of opium, ½ dr.	,, ,, 2 oz.
,, *Terebinthinæ*, .	Oil of turpentine, 1 oz.	,, ,, 15 oz.
,, *Asafœtidæ*, .	Assafœtida, 30 grs.; rubbed into an emulsion with	Distilled water, 4 oz.

Essentiæ, or Essences.—Concentrated rectified spirit solutions of volatile oils, prepared by mixing:—

Essentia Anisi, ... 1 in 5. Dose 10 to 20 minims.
,, *Menthæ Piperitæ*, ... 1 in 5. ,, ,, ,,

In France, volatile oils are termed essences, spiritous solutions of the same prepared by distillation are termed *alcoolats*, spiritous solutions of the same or of other non-volatile bodies prepared by mixing are termed *alcoolés*.

Glycerina, or Glycerines.—Concentrated permanent solutions of medicinal agents in glycerine.

	Ingredients.	Strength by Weight.	Strength by Volume.
Glycerinum Acid Carbolici,	Carbolic acid and glycerine.	1 in 6	1 in $4\frac{3}{4}$
,, ,, *Gallici,*	Gallic acid and glycerine.	1 in 6	1 in $4\frac{1}{2}$
,, ,, *Tannici,*	Tannic acid and glycerine.	1 in 6	1 in $4\frac{1}{2}$
,, *Aluminis,* .	Alum and glycerine.	1 in $7\frac{1}{4}$	1 in $5\frac{1}{2}$
,, *Amyli,* . .	Starch, glycerine, and water.	1 in 10	1 in 9
,, *Boracis,* . .	Borax, glycerine, and water.	1 in 8	1 in $6\frac{3}{4}$
,, *Plumbi Subacetatis,* .	Acetate and oxide of lead, glycerine, and water. It is afterwards evaporated.	1 in 6	1 in 4
,, *Tragacanthæ,*[1]	Tragacanth, glycerine, and water.	1 in $5\frac{1}{2}$	1 in $5\frac{2}{3}$

Injectiones Hypodermicæ.—These should be concentrated neutral solutions of active principles for injection beneath the skin.

	Composition.	Strength.	Dose.
Injectio Apomorphinæ Hypodermica,	Hydrochlorate of apomorphine, 2 grs.; camphor water, 100 mins.	1 in 50	2 to 8 mins.
,, *Ergotini Hypodermica,*	Ergotin, 100 grs.; camphor water, 200 grs.	1 in 2	3 to 10 mins.
,, *Morphinæ Hypodermica,*	Hydrochlorate of morphine, 92 grs.; solution of ammonia, acetic acid, and water, *q.s.* to 2 oz.	1 gr. acetate in 10 mins.[2]	Commencing with 1 to 2 mins.

Lamellæ, or Discs.—Thin circular gelatine impregnated with soluble active principles, intended for ophthalmic use.

Lamellæ Atropinæ.—Discs of gelatine (and glycerine) each weighing about $\frac{1}{50}$ gr., and containing $\frac{1}{5000}$ gr. sulphate of atropine.

Lamellæ Cocainæ.—Discs of gelatine, with some glycerine, each weighing about $\frac{1}{50}$ gr., and containing $\frac{1}{200}$ gr. hydrochlorate of cocaine.

Lamellæ Physostigminæ.—Discs of gelatine, with some glycerine, each weighing about $\frac{1}{50}$ gr., and containing $\frac{1}{1000}$ gr. of physostigmine.

Liquores, or Solutions.—This numerous class, with the exception of *Liq. Epispasticus* and *Liq. Gutta Percha*, are aqueous solutions of definite chemical bodies.

[1] A semisolid used only as an excipient for pill-masses, &c.

[2] Pure morphine is first precipitated with the ammonia and redissolved in the acetic acid.

	Strength.	Dose.
Liquor Acidi Chromici, .	25 per cent. anhydrous	Used externally.
,, *Ammoniæ,* . .	1 in 3 (10 per cent. NH_3)	10 to 30 m.
,, ,, *Fortior,* .	32·5 per cent.	Used externally.
,, *Ammonii Acetatis,* .	1 in 5	2 to 6 drs.
,, ,, *Acet. Fortior,*	about 30 per cent.	25 to 75 m.
,, ,, *Cit. Fortior,*	68 per cent.	½ to 1½ drs.
,, ,, *Citratis,* .	1 in 4	2 to 6 drs.
,, *Antimonii Chloridi,*	36 per cent.	Used externally.
,, *Arsenicalis,* . .	1 in 100	2 to 8 m.
,, *Arsenici Hydrochloricus,*	1 in 100	2 to 8 m.
,, *Arsenii et Hydrg. Iod.,*	1 in 100	10 to 30 m.
,, *Atropinæ Sulphatis,*	1 in 100	1 to 4 m.
,, *Bismuth. et Ammon. Cit.*	3 grs. in 1 dr.	½ to 1 dr.
,, *Calcii Chloridi,* .	1 in 6	15 to 50 m.
,, *Calcis,* . . .	½ gr. in 1 oz.	1 to 4 oz.
,, ,, *Chlorinatæ,* .	2 to 3 per cent. Cl.	10 to 20 m.
,, ,, *Saccharatus,* .	7 grs. in 1 oz.	15 to 60 m.
,, *Chlori,* . . .	2·6 grs. in 1 oz.	10 to 20 m.
,, *Epispasticus,* . .	1 in 4	Used externally.
,, *Ferri Acetatis,* . .	1 in 4	5 to 30 m.
,, ,, *Acet. Fort.,* .	40 per cent.	1 in 8 m.
,, ,, *Dialysatus,* .	5 per cent.	10 to 30 m.
,, ,, *Perchloridi,* .	1 in 4	10 to 30 m.
,, ,, ,, *Fortior,*	1 oz. iron in 5	2 to 8 m.
,, ,, *Pernitratis,* .	1 oz. iron in 30	10 to 40 m.
,, ,, *Persulphatis,* .	36 per cent.	...
,, *Gutta Percha,* . .	1 in 9	Used externally.
,, *Hydrargyri Nit. Acidus,*	48 per cent.	Used externally.
,, *Hydrargyri Perchloridi*	½ gr. in 1 oz.	½ to 2 drs.
,, *Iodi,*	22 grs. in 1 oz.	5 to 10 m.
,, *Lithiæ Effervescens,* .	10 grs. in 1 pint.	5 to 10 oz.
,, *Magnesii Carbonatis,*	10 grs. in 1 oz.	1 to 2 oz.
,, ,, *Citratis,* .	3½ per cent.	5 to 10 oz.
,, *Morphinæ Acetatis,* .	1 in 100	10 to 60 m.
,, ,, *Bimeconatis,*	1¼ in 100	5 to 40 m.
,, ,, *Hydrochloratis,*	1 in 100	10 to 60 m.
,, *Plumbi Subacetatis,* .	24 per cent.	½ to 2 m.
,, ,, ,, *Dilutus,*	1 in 80	½ to 2 drs.
,, *Potassæ,* . . .	27 grs. in 1 oz.	15 to 60 m.
,, ,, *Effervescens,*	30 grs. in 1 pint.	5 to 10 oz.
,, *Potassii Permanganatis,*	1 in 100	2 to 4 drs.
,, *Sodæ,*	18·8 grs. in 1 oz.	15 to 60 m.
,, ,, *Chlorinatæ,* .	2½ per cent. Cl.	10 to 20 m.
,, ,, *Effervescens,* .	30 grs. in 1 pint.	5 to 10 oz.
,, *Sodii Arseniatis,* .	1 in 100	5 to 10 drs.
,, ,, *Ethylatis,* .	19 per cent.	Used externally.
,, *Strychninæ Hydrochloratis,*	1 in 100	5 to 10 m.
,, *Zinci Chloridi,* . .	46 grs. in 1 dr.	Used externally.

Linimenta, or Liniments.—External applications of an oily or spiritous consistence, intended to be rubbed upon the parts affected. *Lin. Iodi* and *Lin. Aconiti* are used rather as paints. (*Pigmenta, q.v.*)

	Composition.	Strength.
Linimentum Aconiti,[1] .	20 oz. root, 1 oz. camphor, to 30 oz. rectified spirit.	1 in $1\frac{1}{2}$
,, *Ammoniæ*, .	1 oz. solution of ammonia, 3 oz. olive-oil.	1 in 4
,, *Belladonnæ*,[1].	20 oz. root, 1 oz. camphor, to 30 oz. rectified spirit.	1 in $1\frac{1}{2}$
,, *Calcis*, . .	2 oz. lime-water, 2 oz. olive-oil, agitated together.	1 in 2
,, *Camphoræ*, .	1 oz. camphor in 4 oz. olive-oil.	1 in 4
,, *Camphoræ Co.*,	$2\frac{1}{2}$ oz. camphor, 1 dr. oil of lavender, 5 oz. strong solution of ammonia, 15 oz. rectified spirit.	1 in 9
,, *Chloroformi*, .	2 oz. chloroform, 2 oz. camphor liniment.	1 in 2
,, *Crotonis*, .	1 oz. croton-oil, $3\frac{1}{2}$ oz. each of oil of cajuput and rectified spirit.	1 in 8
,, *Hydrargyri*, .	1 oz. each of mercurial ointment, solution of ammonia, and liniment of camphor, rubbed together.	1 of oint. in 3 oz. 1 of Hg in 6
,, *Iodi*, . .	$1\frac{1}{4}$ oz. iodine, $\frac{1}{2}$ oz. iodide of potassium, $\frac{1}{4}$ oz. glycerine, dissolved in 10 oz. rectified spirit.	1 in 9
,, *Opii*, . .	2 oz. tincture of opium, and 2 oz. soap liniment.	1 in 2
,, *Potassii Iodidi cum Sapone*,	2 oz. curd soap, $1\frac{1}{2}$ oz. iodide of potas., 1 oz. glycerine, 1 dr. oil of lemon, and 10 oz. distilled water. (A semisolid.)	$54\frac{1}{2}$ grs. in 1 fl. oz., or 1 in 10 by weight.
,, *Saponis*, .	2 oz. hard soap, 1 oz. camphor, 3 drs. of rosemary, 4 oz. distilled water, and 16 oz. rectified spirit.	1 in 12
,, *Sinapis Co.*, .	1 dr. oil of mustard, 40 grs. ethereal extract of mezereon, 120 grs. camphor, 5 drs. castor-oil, and 4 oz. rectified spirit.	1 in 40
,, *Terebinthinæ*,	2 oz. soft soap, 1 oz. camphor, 16 oz. oil of turpentine, and 2 oz. water.	4 in 5
,, *Terebinth. Acet.*	4 oz. oil of turpentine, 1 oz. glacial acetic acid, and 4 oz. camphor liniment.	4 in 9

[1] Prepared by maceration and percolation.

Lotiones, or Lotions.—Local applications applied with lint or other dressing material.

Lotio Hydrargyri Flava.—18 grs. hyd. perchlor. and 10 oz. lime-water.
Lotio Hydrargyri Nigra.—30 grs. calomel and 10 oz. lime-water.

Mellita, or Honeys.—Syrupy liquids containing honey.

Mel Depuratum.—Honey melted and strained through flannel.
Mel Boracis.—60 grs. powdered borax, mixed with 480 grs. honey and 30 grs. glycerine.

Misturæ, or mixtures (for definition *cf.* Index).—The dose of each is about 1 fluid ounce.

	Composition.	Strength per oz.
Mistura Ammoniaci, .	4 oz. ammoniacum rubbed up with 8 oz. water, and strained.	$13\frac{1}{2}$ grs.
,, *Amygdalæ*, .	2 oz. compound powder of almonds and 16 oz. water, and strained.	54 grs.
,, *Creasoti*, . .	15 minims each creasote and glacial acetic acid, 1 oz. syrup, $\frac{1}{2}$ dr. spirit of juniper, 15 oz. water.	1 minim.
,, *Cretæ*, . .	Prepared chalk, $\frac{1}{4}$ oz.; powd. acacia, $\frac{1}{4}$ oz.; syrup, $\frac{1}{2}$ oz.; cinnamon-water, $7\frac{1}{2}$ oz.	$13\frac{1}{2}$ grs.
,, *Ferri Aromatic*,[1]	1 oz. red bark, $\frac{1}{2}$ oz. calumba root, $\frac{1}{4}$ oz. cloves, $\frac{1}{2}$ oz. iron wire, 3 oz. compound tincture of cardamoms, $\frac{1}{2}$ oz. tincture of orange-peel, peppermint-water to 16 oz.	
,, ,, *Comp.*, .	25 grs. sulphate of iron, 30 grs. carbonate of potassium, 60 grs. myrrh, 60 grs. sugar, 4 drs. spirit of nutmeg, $9\frac{1}{2}$ oz. rose-water.	$2\frac{1}{2}$ grs.
,, *Guaiaci*, . .	$\frac{1}{2}$ oz. guaiacum resin, $\frac{1}{2}$ oz. sugar, $\frac{1}{4}$ oz. gum acacia powdered, and 20 oz. cinnamon-water.	11 grs.
,, *Scammoni*, .	6 grs. scammony in 7 oz. milk.	3 grs.
,, *Sennæ Co.*, .	4 oz. sulphate of magnesium, 1 oz. liq. extract of liquorice, $2\frac{1}{2}$ oz. tincture of senna, $1\frac{1}{2}$ oz. compound tincture of cardamoms, and infusion of senna, 15 oz.	1 dr. tinct. and 87 grs. mag. sulph.
,, *Spt. Vini Gallici*,	4 oz. brandy, 4 oz. cinnamon-water, the yolk of 2 eggs, $\frac{1}{2}$ oz. sugar.	3 drs.

[1] Prepared by maceration and filtration.

Mucilagines, or Mucilages.—Viscid aqueous solutions of gum or starch.

Mucilago Acaciæ.—4 oz. gum acacia dissolved in 6 oz. distilled water.
Mucilago Amyli.—120 grs. starch boiled in 10 oz. distilled water.
Mucilago Tragacanthæ.—60 grs. of the powdered gum mixed with 2 drams rectified spirit, and 10 oz. distilled water added.

Oxymellita, or Oxymels.—Preparations containing honey and acetic acid.

Oxymel.—40 oz. honey, 5 oz. acetic acid, and 5 oz. distilled water.
Oxymel Scillæ.—1 pint vinegar of squill and 2 lbs. honey.

Pilulæ, or Pill-masses.—Plastic preparations of the consistence of firm clay, made by beating medicaments together in a metal mortar. Required quantities are intended to be rolled into pills for the use of a patient, as required. Dose, about 5 to 10.

	Ingredients.	Strength.
Pilula Aloës Barbadensis,	Barbadoes aloes, hard soap, oil of caraway, and confection of roses.	1 in 2
,, *Aloës et Asafœt.*, .	Socotrine aloes, asafœtida, hard soap, and confection of roses.	1 in 4
,, ,, *Ferri,* .	Sulphate of iron, Barbadoes aloes, compound powder of cinnamon, and confection of roses.	1 in 7
,, ,, *Myrrhæ,* .	Socotrine aloes, myrrh, saffron, treacle, and glycerine.	1 in 3
,, *Aloës Socotrinæ,* .	Socotrine aloes, hard soap, volatile oil of nutmeg, and confection of roses.	1 in 2
,, *Asafœtidæ Co.,* .	Asafœtida, galbanum, myrrh, and treacle.	1 in 3½
,, *Cambogiæ Co.,* .	Gamboge, Barbadoes aloes, hard soap, compound powder of cinnamon, and syrup.	1 in 6
,, *Colocynth Co.,* .	Colocynth, Barbadoes aloes, scammony resin, sulphate of potassium, oil of cloves, and water.	1 in 6
,, ,, *et Hyoscyami,*	Compound colocynth pill and extract of hyoscyamus.	2 and 1 in 3
,, *Conii Co.,* . .	Extract of hemlock, ipecac., and treacle.	2½ in 3
,, *Ferri Carb.,* . .	Saccharated carbonate of iron and confection of roses.	1 in 1¼
,, ,, *Iodidi,* .	Iron wire, iodine, sugar, powdered liquorice, and distilled water.	1 in 3½
,, *Hydrargyri,* . .	Mercury, confection of roses, and powdered liquorice.	1 in 3
,, ,, *Subchlor. Co.,*	Calomel, sulphurated antimony, guaiacum resin, and castor-oil.	1 in 5
,, *Ipecacuanhæ cum Scilla,*	Dover's powder, squill, ammoniacum, and treacle.	1 in 23

	Ingredients.	Strength.
Pilula Plumbi c. Opio, .	Acetate of lead, opium, and confection of roses.	6 and 1 in 8
,, *Phosphori*, . .	Phosphorus, balsam of tolu, yellow wax, and curd soap.	1 in 90
,, *Rhei Co.*, . .	Rhubarb, Socotrine aloes, myrrh, hard soap, oil of peppermint, treacle, and glycerine.	1 in 4¼
,, *Saponis Co.*, .	Opium, hard soap, and glycerine.	1 in 6 (opium)
,, *Scammonii Co.*, .	Resins of scammony and jalap, curd soap, strong tincture of ginger, and rectified spirit.	1 in 3¼
,, *Scillæ Co.*, . .	Squill, ginger, ammoniacum, hard soap, and treacle.	1 in 5

Pulveres, or Powders.—Mixtures of the impalpable powders of drugs.

	Ingredients.	Dose in Grains.	Strength of Active Ingredient.
Pulvis Amygdalæ Co., .	Sweet almonds, refined sugar, and acacia gum.	10 to 60	8 in 13
,, *Antimonialis*, .	Oxide of antimony and phosphate of calcium.	3 to 5	1 in 3
,, *Catechu Co.*, .	Catechu, kino, rhatany root, cinnamon, and nutmeg.	20 to 40	1 in 2½
,, *Cinnamomi Co.*, .	Cinnamon, cardamoms, and ginger.	3 to 10	1 in 3
,, *Cretæ Aromaticus*,	Cinnamon, nutmeg, saffron, cloves, cardamoms, sugar, and chalk.	10 to 60	1 in 4½
,, ,, *Aromat. c. Opio*,	Aromatic chalk powder, and opium.	10 to 40	1 in 40 (opium)
,, *Elaterini Co.*, .	Elaterin and sugar of milk.	½ to 5	1 in 40
,, *Glycyrrhizæ Co.*,	Senna, liquorice root, sugar, fennel fruit, and sulphur.	30 to 60	1 in 6
,, *Ipecacuanhæ Co.*,	Ipecacuanha, opium, and sulphate of potassium.	5 to 15	1 in 10
,, *Jalapæ Co.*, . .	Jalap, cream of tartar, and ginger.	20 to 60	1 in 3
,, *Kino Co.*, . .	Kino, opium, and cinnamon.	5 to 20	1 in 20 (opium)
,, *Opii Co.*, . .	Opium, black pepper, ginger, caraway, and tragacanth.	2 to 5	1 in 10
,, *Rhei Co.*, . .	Rhubarb, light magnesia, and ginger.	20 to 60	1 in 4½
,, *Scammonii Co.*, .	Scammony resin, jalap, and ginger.	10 to 20	1 in 2
,, *Tragacanthæ Co.*,	Tragacanth, gum, acacia, starch, and sugar.	20 to 60	1 in 6

Spiritus, or Spirits.—Alcoholic solutions of volatile oils and camphors. Mixed with water they frequently become turbid, due to separation of oil. Some are prepared by distillation (*q.v.*).

	Composition.	Strength.	Dose.
Spiritus Ætheris, .	Ether and spirit.	1 in 3	½ to 1½ drs.
,, ,, *Compos.*,	Ethereal oil, ether, and spirit and other compounds.	1 in 64	½ to 2 drs.
,, ,, *Nitrosi*,	A spiritous solution of nitrous compounds (distilled).	Sp. Gr. ·840–·845	½ to 2 drs.
,, *Ammoniæ Aromaticus* (*sal volatile*),	Carbonate, strong solution of ammonia, v. oil of nutmeg, oil of lemon, spirit, and water (distilled).	1 in 40 (Carbonate) 1 in 20 (Liq. Am. F.)	½ to 1 dr.
,, *Ammoniæ Fœtidus*,	Assafœtida, strong solution of ammonia, and spirit (distilled).	1½ in 20	½ to 1 dr.
,, *Armoraciæ Compos.*,	Horse-radish root, bitter orange-peel, nutmeg, proof spirit, and water (distilled).	1 in 8	1 to 2 drs.
,, *Cajuputi*, .	Oil of cajuput and spirit.	1 in 50	½ to 1 dr.
,, *Camphoræ*, .	Camphor and spirit.	1 in 10	10 to 30 m.
,, *Chloroformi*, .	Chloroform and spirit.	1 in 20	20 to 60 m.
,, *Cinnamomi*, .	Oil of cinnamon and spirit.	1 in 50	½ to 1 dr.
,, *Juniperi*, .	Oil of juniper and spirit.	1 in 50	½ to 1 dr.
,, *Lavandulæ*, .	Oil of lavender and spirit.	1 in 50	½ to 1 dr.
,, *Menthæ Piperitæ*,	Oil of peppermint and spirit.	1 in 50	½ to 1 dr.
,, *Myristicæ*, .	Volatile oil of nutmeg and spirit.	1 in 50	½ to 1 dr.
,, *Rectificatus*, .	Alcohol, with 16 per cent. of water.	56 per cent. over proof	...
,, *Rosmarini*, .	Oil of rosemary and spirit.	1 in 50	½ to 1 dr.
,, *Tenuior* (Proof Spirit),	Spirit 5 pints and water 3 pints.	49 per cent. alcohol	...
,, *Vini Gallici* (Brandy),	Spirit distilled from French wine.	About 50 per cent.	...

Suppositoria.—Conically-formed solids for administration *per rectum*. (For their preparation, *cf.* Index.)

	Ingredients.	Strength each (15 Grs.).
Suppositoria Acidi Carbolici cum Sapone,	Carbolic acid, curd soap, and glycerine of starch.	1 gr.
,, *Acidi Tannici,*	Tannic acid and oil of theobroma.	3 grs.
,, *Acidi Tannici cum Sapone,*	Tannic acid, glycerine of starch, curd soap, and starch.	3 grs.
,, *Hydrargyri,* .	Ointment of mercury and oil of theobroma.	5 grs. (ungt.)
,, *Iodoformi,* .	Iodoform and oil of theobroma.	3 grs.
,, *Morphinæ,* .	Hydrochlorate of morphine and oil of theobroma.	½ gr.
,, *Morphinæ cum Sapone,*	Hydrochlorate of morphine, glycerine of starch, curd soap, and starch.	½ gr.
,, *Plumbi Co.,* .	Acetate of lead, opium, and oil of theobroma.	3 grs. and 1 gr. opium.

Syrupi, or **Syrups.**—The sp. gr. of simple Syrup is 1·33; it is made by dissolving the sugar in water with the aid of heat, and, as is the case with all the other syrups, the product is made up to a given weight, thereby ensuring uniformity of consistence.

The syrups of Ginger and Orange are prepared directly from their tinctures; that of Chloral, by solution.

	Ingredients.	Strength (by Volume).
Syrupus Simplex, ...	Sugar, 5 lbs.; water, 2½ lbs.	1 in 1⅛
,, *Aurantii,*	Syrup and tincture of orange-peel.	1 in 8
,, ,, *Floris,* . .	Orange-flower water, sugar, and water.	1 in 6¾
,, *Chloral,*	Hydrate of chloral, syrup, and water.	1 in 6
,, *Ferri Iodidi,*	Iron wire, iodine, sugar, and water; each dram contains 4·3 grains.	1 in 14
,, *Ferri Phosphatis,* .	Granulated sulphate of iron, bicarbonate and phosphate of sodium, concentrated phosphoric acid, sugar, and water; 1 gr. in each dram.	1 in 60
,, *Hemidesmi,*	Hemidesmus root, sugar, and water.	1 in 8
,, *Limonis,*	Fresh lemon-peel, lemon-juice, and sugar.	1 in 2

	Ingredients.	Strength (by Volume).
Syrupus Mori, ...	Mulberry juice, sugar, and rectified spirit.	1 in 2
,, *Papaveris*, . . .	Capsules freed from seeds, rectified spirit, sugar, and water.	1 in $2\frac{1}{5}$
,, *Rhei*, ...	Rhubarb root, coriander fruit, sugar, rectified spirit, and water.	1 in 15
,, *Rhœados*, . . .	Fresh red-poppy petals, sugar, water, and rectified spirit.	1 in $3\frac{1}{2}$
,, *Rosæ Gallicæ*, . .	Dried red-rose petals, sugar, and water.	1 in 17
,, *Scillæ*, ...	Vinegar of squill and sugar.	1 in 17
,, *Sennæ*, ...	Senna leaves, oil of coriander, sugar, water, and rectified spirit.	1 in 2
,, *Tolutanus*, . . .	Balsam of tolu, sugar, and water.	1 in 29
,, *Zingiberis*, . . .	Strong tincture of ginger and syrup.	1 in 26

Tabellæ, or Tablets.—Chocolate impregnated with medicaments.

Only one—*Tabellæ Nitroglycerini*, $\frac{1}{100}$ gr. in each.

Tincturæ, or Tinctures (the ten prepared by mixing).

	Ingredients.	Strength.	Dose.
Tinctura Cannabis Indicæ,	Extract Cannab. Ind. 1 oz. to 20 oz. s.v.r.	1 in 20	1 to 20 m.
,, *Chloroformi Co.*,	Chlorof. 2; s.v.r., 8; Tr. Card. Co., 10.	1 in 10	20 to 60
,, ,, *et Morphinæ* (Chlorodyne)	1 oz. chloroform, 2 drms. ether, 1 oz. spirit, 8 grs. hydrochlorate of morphine, $\frac{1}{2}$ oz. prussic acid, 4 m. oil of peppermint, 1 oz. liq. ext. liquorice, 1 oz. treacle, syrup, *q.s.* to 8 oz.	1 in 8 (chloroform), 1 gr. in 1 oz. (morphine).	5 to 10 m.
,, *Ferri Acetatis*, .	5 oz. strong solution of acetate of iron, 1 oz. acetic acid, 5 oz. rectified spirit, 9 oz. distilled water.	1 in 4	5 to 30 m.
,, ,, *Perchloridi*,	Strong solution of perchloride, 5 oz.; s.v.r., 5 oz.; distilled water, 10 oz.	1 in 4	10 to 30

	Ingredients.	Strength.	Dose.
Tinctura Iodi, . . .	½ oz. iodine, ½ oz. iodide of potassium, rectified spirit.	1 in 40	5 to 20 m.
,, *Nucis Vomicæ,* .	Extract, 133 grs.; water, 4 oz.; s.v.r. to 20 oz.	1 gr. of alkaloids in 1 fl. oz.	10 to 20
,, *Podophylli,* .	160 grs. of resin to 20 oz. s.v.r.	1 gr. in 1 dr.	15 to 60
,, *Quininæ Ammoniata* (with application of heat),	160 grs. sulphate of quinine, 2½ oz. solution of ammonia, proof spirit.	1 in 60	½ to 2 dr.
,, *Quininæ,* . .	160 grs. of hydrochlorate to pint of tincture of orange-peel.	8 grs. to 1 oz.	½ to 2 dr.

Trochisci, or Lozenges.—Medicaments for obtaining a mild continuous local action of a drug; their basis is gum and sugar.

	Ingredients.	Grains in each.
Trochisci Acidi Benzoici, .	Benzoic acid, sugar, gum, mucilage, and water.	½ gr.
,, ,, *Tannici,* .	Tannin, tincture of tolu, sugar, gum, mucilage, and water.	½ gr.
,, *Bismuthi,* . .	Subnitrate of bismuth, carbonate of magnesium, carbonate of calcium, sugar, gum, mucilage, and rose-water.	2 grs.
,, *Catechu,* . . .	Catechu, sugar, gum, mucilage, and water.	1 gr.
,, *Ferri Redacti,* .	Reduced iron, sugar, gum, mucilage, and water.	1 gr.
,, *Ipecacuanhæ,* . .	Ipecacuanha, sugar, gum, mucilage and water.	¼ gr.
,, *Morphinæ,* . .	Hydroch. of morphine, tincture of tolu, sugar, gum, mucilage, and water.	$\frac{1}{36}$ gr.
,, *Morphinæ et Ipecac.*	Do., with the addition of ipecacuanha.	$\frac{1}{36}$ and $\frac{1}{12}$
,, *Opii,* . . .	Extract of opium, tincture of tolu, sugar, gum, extract of liquorice, and water.	$\frac{1}{10}$ gr.
,, *Potassii Chloratis,* .	Chlorate of potassium, sugar, gum, mucilage, and water.	5 grs.
,, *Santonini,* . .	Santonin, sugar, gum, mucilage, and water.	1 gr.
,, *Sodii Bicarb.,* .	Bicarbonate of sodium, sugar, gum, mucilage, and water.	5 grs.

Unguenta, or Ointments.

	Composition.	Strength.
Unguentum Acidi Borici, .	Boric acid, soft and hard paraffin.	1 in 7
,, ,, *Carbolici*,	Carbolic acid, soft and hard paraffin.	1 in 19
,, ,, *Salicylici*,	Salicylic acid, soft and hard paraffin.	1 in 28
,, *Aconitinæ*, .	Aconitine, spirit, benzoated lard.	8 grs. to 1 oz.
,, *Antim. Tartar.*,	Tartar emetic and simple ointment.	1 in 5
,, *Atropinæ*, . .	Atropine, spirit, and benzoated lard.	8 grs. to 1 oz.
,, *Belladonnæ*, .	Alcoholic extract and benzoated lard.	50 grs. to 1 oz.
,, *Calaminæ*, .	Prepared calamine and benzoated lard.	1 in 6
,, *Cantharides*, .	Cantharides, yellow wax, olive-oil.	1 in 8
,, *Cetacei*, . .	Spermaceti, white wax, almond-oil, and benzoin.	1 in 5
,, *Chrysarobini*, .	Chrysarobini and benzoated lard.	1 in 25
,, *Creasoti*, . .	Creasote and simple ointment.	1 in 9
,, *Elemi*, . .	Elemi and simple ointment.	1 in 5
,, *Eucalypti*, .	Oil of eucalyptus, soft and hard paraffin.	1 in 5
,, *Gallæ*, . .	Galls and benzoated lard.	80 grs. to 1 oz.
,, ,, *cum Opio*,	Ointment of galls and opium.	32 grs. to 1 oz.
,, *Glycerini Plumbi Subacetatis*,	Glycerine of subacetate of lead, soft and hard paraffin.	1 in 6
,, *Hydrargyri*, .	1 lb. mercury, 1 lb. lard, 1 oz. suet.	1 in 2
,, ,, *Ammoniati*,	50 grs. ammoniated mercury, 450 grs. simple ointment.	1 in 10
,, ,, *Comp.*, .	6 oz. mercurial ointment, 3 oz. olive-oil, 3 oz. yellow wax, 1½ oz. camphor.	1 in 4½ (of Hg)
,, ,, *Iodidi Rubri*,	16 grs. red iodide, 1 oz. simple ointment.	16 grs. to 1 oz.
,, ,, *Nitratis*, .	4 oz. mercury, 12 oz. nitric acid, 15 oz. lard, 32 oz. olive-oil.	1 in 15½ (of Hg)

	Composition.	Strength.
Unguentum Hyd. Nitratis Dil., . .	1 oz. ointment of nitrate of mercury, 2 oz. soft paraffin.	1 in 3
,, ,, *Oxidi Rubri*,	62 grs. red precipitate, ¼ oz. hard paraffin, and ¾ oz. soft paraffin.	1 in 8
,, ,, *Subchloridi*,	80 grs. calomel, 1 oz. benzoated lard.	80 grs. to 1 oz.
,, *Iodi*, . . .	Iodine, iodide of potassium, glycerine, and lard.	1 in 31
,, *Iodoformi*, .	Iodoform and benzoated lard.	1 in 10
,, *Picis Liquidæ*, .	Tar and yellow wax.	5 in 7
,, *Plumbi Acetatis*,	Acetate of lead and benzoated lard.	12 grs. to 1 oz.
,, ,, *Carbonatis*,	Carbonate of lead, and simple ointment.	1 in 8
,, ,, *Iodidi*, .	Iodide of lead and simple ointment.	1 in 8
,, *Potassæ Sulphuratæ*,	Sulphurated potash, hard and soft paraffin.	30 grs. to 1 oz.
,, *Potassii Iodidi*,	Iodide and carbonate of potassium, water, and benzoated lard.	1 in 8¾
,, *Resinæ*, . .	Resin, yellow wax, almond-oil, and simple ointment.	1 in 3¾
,, *Sabinæ*, . .	Fresh savin top, yellow wax, and benzoated lard.	8 to 19
,, *Simplex*, . .	White wax, 2 oz.; benzoated lard, 3 oz.; and almond-oil, 3 oz.	...
,, *Staphisagriæ*, .	Stavesacre seeds and benzoated lard.	1 in 3
,, *Sulphuris*, .	Sublimed sulphur, benzoated lard.	1 in 5
,, *Sulphuris Iodidi*,	Iodide of sulphur, hard and soft paraffin.	30 grs. to 1 oz.
,, *Terebinthinæ*, .	Oil of turpentine, resin, yellow wax, and lard.	1 in 2
,, *Veratrinæ*, .	Veratrine, olive-oil, hard and soft paraffin.	1 in 63
,, *Zinci*, . .	Oxide of zinc and benzoated lard.	80 grs. to 1 oz.
,, ,, *Oleati*, .	Oleate of zinc and soft paraffin.	1 in 2

Cerates, as the name implies, contain wax, and possess a consistence intermediate between ointments and plasters.

Vapores, or Inhalations.[1]—Volatile medicaments for inhalation from suitable apparatus known as "inhalers" (*vide* p. 218).

	Ingredients.
Vapor Acidi Hydrocyanici,	10 to 15 mins. diluted hydrocyanic acid in 1 dr. cold water, and the vapour to be inhaled.
,, *Chlori*, . . .	2 oz. chlorinated lime, cold water *q.s.*, do.
,, *Coninæ*, . . .	½ oz. juice of hemlock, 1 dr. solution of potash, 1 oz. water; 20 mins. to be inhaled from hot water.
,, *Creasoti*, . . .	12 mins. creasote and 8 oz. boiling water.
,, *Iodi*, . . .	1 dr. tincture of iodine, 1 oz. water, and apply heat before inhaling.
,, *Olei Pini Sylvestris*,	40 mins. fir-wool oil, 20 grs. light carbonate of magnesium, water to 1 oz.; 1 dram. of this to be added to ½ pint boiling water and ½ pint cold water.

Preparations containing Opium.

Confectio Opii, ...	1 part in 40, nearly.
Emplastrum Opii, ...	1 part in 10.
Enema Opii, ...	½ fluid drm. tincture to 2 fluid ounce.
Extractum Opii, ...	about 1 part from 2.
,, ,, *Liquidum*, . .	22 grs. extract in 1 fluid oz., nearly.
Linimentum Opii, ...	1 volume tincture in 2 volumes.
Pilula Ipecacuanhæ cum Scilla, .	1 part in 23, nearly.
,, *Plumbi cum Opio*, . .	1 part in 8.
,, *Saponis Composita*, . .	1 part in 6, nearly.
Pulvis Cretæ Aromaticus cum Opio,	1 part in 40.
,, *Ipecacuanhæ Compositus*, .	1 part in 10.
,, *Kino Compositus*, . .	1 part in 20.
,, *Opii Compositus*, . .	1 part in 10.
Suppositoria Plumbi Composita, .	1 grain in each suppository.
Tinctura Camphoræ Composita, .	2 grains to 1 fluid ounce.
,, *Opii*, ...	33 grains to 1 fluid ounce, nearly.
,, ,, *Ammoniata*, . .	5 grains to 1 fluid ounce.
Trochisci Opii, ...	$\frac{1}{10}$ grain of extract in each.
Unguentum Gallæ cum Opio, . .	32 grains to 1 ounce.
Vinum Opii, ...	22 grs. extract in 1 fluid oz., nearly.

Preparations of Opium Alkaloids.

Morphinæ Acetas, ...	about 1 part from 8 or 10 of opium.
,, *Acetatis Liquor*, . .	4½ grs. acetate in 1 fluid ounce.
,, *Bimeconatis Liquor*, .	5½ grs. bimeconate in 1 fluid ounce.
,, *Hydrochloras*, . .	about 1 part from 8 or 10 of opium.

[*continued*.

[1] Under this general title are comprehended two distinct species, viz., dry fumes of volatile or burning substances (*Suffitus*), and watery vapours (*Halitus*). (Paris.)

Morphinæ Hydrochloratis Liquor, .	$4\frac{1}{2}$ grs. hydrochlorate in 1 fluid ounce.
,, *Hypoderm. Inject.*, . .	1 grain of acetate in 10 minims.
,, *Sulphas*, ...	about 1 part from $7\frac{1}{2}$ of opium.
Codeina, ...	...
Apomorphinæ Hydrochloras, . .	(Obtained by heating morphine or codeine in a sealed tube with hydrochloric acid.)

LABORATORY COURSE.

I.

Take of Rhubarb root, . . .	$\frac{1}{4}$ ounce.
,, Boiling distilled water, .	10 fluid ounces.

Having reduced the rhubarb to thin slices, infuse in a covered vessel with the water for half an hour, and strain. The strained liquid is *Infusum* Rhei.

Divide the infusion into two equal parts; evaporate the one to dryness on a water-bath (the residue constitutes a dry aqueous extract of rhubarb). Of the remaining part of the infusion, put a portion into each of six test-tubes; to the first add solution of ammonia (the colour is deepened); to the second add lime-water (the colour is deepened, and subsequently a precipitate appears, especially on heating); to the third add solution of a ferric or ferrous salt (a finely-divided black precipitate is produced); to the fourth add solution of subacetate of lead (a dense precipitate produced); to the fifth add some freshly-prepared animal charcoal, shake well, filter (the filtrate passes colourless); to the sixth add twice its volume of rectified or methylated spirit, set aside for twenty-four hours (mucilaginous matter is precipitated).

II.

Take of Quassia wood, in small chips, .	55 grains.
,, Cold distilled water, . .	10 fluid ounces.

Macerate the quassia with the water in a covered vessel for half an hour, and strain.

The strained liquid is *Infusum* Quassiæ.

Apply to the infusion the reagents enumerated in the previous experiment.

III.

Take of Logwood, in small chips, . . . ½ ounce.
,, Distilled water, ... ½ pint.

Boil the logwood in the water (in a porcelain dish) for ten minutes, then strain the liquid into an earthenware vessel through a plug of tow or cotton-wool wedged in the neck of an earthenware funnel. The strained liquid constitutes a *decoction.* (Cf. *Decoct. Hæmatoxyli.*)

Divide the decoction into two equal portions.

(*a*) Evaporate the one to dryness in a porcelain dish on a water-bath; the residue is *Extractum* Hæmatoxyli.

(*b*) Dilute the other with three times its volume of cold water, and put a portion into each of five test-tubes; add then the following reagents:—To the first, solution of ammonia (the fluid assumes a purple coloration); to the second, lime-water (a purple precipitate is produced, colouring matter removed); to the third, solution of lead acetate (colour precipitated); to the fourth, solution of iron sulphate (a finely-divided black precipitate, ink); to the fifth add freshly-prepared animal charcoal, shake vigorously for a few seconds, throw upon a filter, the fluid passes colourless.

Observation.—Infusions and decoctions are extemporaneous preparations,[1] only intended to be prepared as required for use; by keeping they decompose, emitting a fœtid odour. The appearance of all infusions and decoctions is more or less affected by solutions of the alkalis, alkaline earths, and soluble salts of the heavy metals, as evidenced in the above experiments—quassia and calumba, however, are notable exceptions in so far as they contain no astringent matters, and accordingly do not yield black or dark-coloured precipitates with salts of iron. The above reactions explain the occurrence of a great many of the so-called incompatibilities which occur in practical dispensing; solutions of crude vegetable matter are therefore (in general terms) deepened in colour by salts of the alkalis, but not precipitated (unless the solution be of an alkaloidal nature); soluble salts of the alkaline earths partially precipitate them, more effectually on boiling; soluble salts of the heavy metals effectually precipitate them; in aqueous solutions, alcohol precipitates them (gum and albumin). We have seen that

[1] *Decoctum Aloës Compositum* is the only exception; it contains Compound Tincture of Cardamoms, the alcohol in the latter rendering the preparation capable of being preserved intact for a long period.

the process of infusion or decoction constitutes an initial operation in the preparation of extracts from drugs which readily yield their virtues to water.

IV.

(*a*).

Take of Calumba root, ...	$2\frac{1}{2}$ ounces.
„ Proof spirit, ...	1 pint.

Cut the root small and macerate it for forty-eight hours in 15 fluid ounces of the spirit, in a closed vessel, agitating occasionally; then transfer to a percolator, and when the fluid ceases to pass, continue the percolation with the remaining five ounces of spirit. Afterwards subject the contents of the percolator to pressure, filter the product, mix the liquids, and add sufficient proof spirit to make one pint.

The finished product is *Tinctura* Calumbæ.

(*b*).

Transfer the above tincture to a clean, narrow-mouthed tin vessel capable of holding two pints, connect with a condensing apparatus, and applying the heat of a Bunsen flame, distil off the spirit until about 9 or 10 ounces of distillate are collected. Reserve the distillate. Empty the liquid remaining in the still into a porcelain dish, and evaporate it by means of a water-bath until the residue is of a plastic consistence.

The plastic residue is a proof spirit extract, viz., *Extractum* Calumbæ.

(*c*).

Ascertain the specific gravity of the alcoholic distillate, using a sp. gr. bottle and balance (cf. *Alcohol tables in Appendix*). Reduce it to "proof."

V.

Macerate eight ounces of cloves in two pints of cold water for 48 hours, strain, introduce the wet cloves together with four pints of clean water and 16 ounces of common salt into a narrow-mouthed tin vessel capable of holding a gallon, connect with a condensing apparatus, and, applying heat, distil a pint of liquid.

Separate the essential oil from the aqueous portion of the distillate. (See *Aquæ*, p. 160.)

(The salt is added to raise the boiling-point of the liquid.)

VI.

Take of Arsenious acid, in powder, ,, Carbonate of potassium,	of each	$43\frac{1}{2}$ grains.
,, Compound tincture of lavender,	.	5 fluid drachms.
,, Distilled water,	. . . .	a sufficiency.

Place the arsenious acid and the carbonate of potassium in a flask with 5 ounces of the water, and apply heat until a clear solution is obtained. Allow this to cool. Then add the compound tincture of lavender, and as much distilled water as will make the bulk 10 fluid ounces. The preparation is *Liquor* Arsenicalis.

VII.

(*a*).

EMPLASTRUM PLUMBI.

(Lead Plaster.)

Take of oxide of lead in fine ,, powder, . .	. .	1 ounce.
,, Olive oil,	. . . . .	2 ounces.
,, Water,	. . . . .	1 ounce.

Heat all the ingredients together in a porcelain dish on a water-bath for from 8 to 10 hours, stirring occasionally until the product acquires a proper consistence for a plaster, and adding more water during the process if necessary.

(*b*).

EMPLASTRUM RESINÆ.

(Resin Plaster.)

To every one part by weight of lead plaster produced, as above, and previously melted on a water-bath, add $\frac{1}{8}$ part of resin and $\frac{1}{16}$ part of curd soap (the two latter having been previously melted together); stir until thoroughly mixed, and allow to cool.

VIII.

(*a*).

MUCILAGO ACACIÆ.

(Mucilage of Gum Acacia.)

Take of Gum acacia in small pieces,	.	4 ounces.
,, Distilled water,	. . .	6 fluid ounces.

Put the gum and water into a covered earthen jar, and stir them

occasionally until the gum is dissolved. If necessary, strain the solution through muslin.

Experiment.—Dilute an ounce of the finished mucilage with an equal quantity of water; to separate portions of the diluted mucilage, add (1) some Liquor Ferri Perchloridi; (2) some solution of Borax; (3) some solution of neutral Lead Acetate; (4) some solution of Lead Subacetate; (5) double the quantity of rectified spirit.

(*b*).

Mucilago Amyli.

(Mucilage of Starch.)

Take of Starch, ...	120 grains.
,, Distilled water, . . .	10 fluid ounces.

Triturate the starch with the water, gradually added, then boil for a few minutes, constantly stirring.

(*c*).

Mucilago Tragacanthæ.

(Mucilage of Tragacanth.)

Take of Tragacanth, in powder, . .	60 grains.
,, Distilled water, ...	10 fluid ounces.
,, Rectified spirit, ...	2 fluid drachms.

Mix the tragacanth with the spirit; then pour in the whole of the water, with constant agitation.

Experiment.—Take a four-ounce phial, pour into it two fluid drachms of rectified spirit, add 60 grains of finely powdered gum "acacia," slightly agitate, and fill up the phial with water. (See Remarks, p. 203.)

PART III.

A PRACTICAL COURSE OF DISPENSING.

The Prescription.—"In medicine the term 'prescription' (*præscriptio*, from *præ*, before, and *scribo*, I write; *ordonnance*, French; *Verordnung*, Germ.; ἀναγραφή[1]) is usually applied to the written directions of a physician or surgeon for the preparation and use of remedies. . . . . In Great Britain, as well as in Germany, prescriptions are usually written in the Latin language. In France, and some other countries, the mother-tongue is employed. There are several reasons for preferring the Latin to the vernacular language in prescriptions—at least for the designation of the ingredients to be employed, and for the directions to the compounder. 'If not spoken, it is written and understood throughout the civilised world; and that cannot be said of any other language. An invalid travelling through many parts of Europe might die before a prescription written in English could be interpreted.'[2] Moreover, Latin professional terms are concise and definite. Furthermore, the Latin names for drugs and chemicals are the same, or nearly so, all over Europe; whereas the vernacular names differ for each nation—nay, sometimes for each province. Lastly, it is sometimes necessary or advisable to conceal from a patient the precise nature of the remedies which are employed.

"These reasons, however, do not equally apply to the use of the Latin language for writing the directions to the patient; for as these are intended for the use of the patient or his attendant, and as, sooner or later, he must have them in English, there does not appear any advantage to be gained in practising a temporary concealment by writing them in a dead language. On the contrary, there are several weighty objections to this practice,—such as the embarrassments which some prescribers feel in giving in good and intelligible Latin the requisite directions for the patient, the imperfect or limited acquaintance with the Latin language possessed by many dispensers or compounders of medicines; and lastly, the difficulty, and in some cases impossibility, of finding concise and intelligible English words which are the exact equivalents of many Latin professional terms not unfrequently used in prescriptions. By throwing on the compounder the responsibility of expressing in appropriate language, and in the brief compass of a label, the exact intentions of the prescriber, in a language which the latter did not use, we greatly augment the risk of errors and mistakes.

"All the Medical Colleges formerly published their pharmacopœias in the Latin language. But the French Codex,[3] and the American,[4] Greek,[5]

[1] Fœsius, *Œconomica Hippocratis.*

[2] Paris' *Pharmacologia*, 9th ed., p. 105, 1843.

[3] *Codex Medicamentarius: Pharmacopée française redigée par ordre du Gouvernement.* Paris, 1866. 8vo.

[4] *The Pharmacopœia of the United States of America.* By authority of the National Medical Convention held at Washington. 8vo.

[5] Ἑλληνικὴ φαρμακοποιΐα. Ἐν Ἀθήναις, 1837. Pharmacopœia Græca. Athenis, 1837.

Edinburgh,[1] and Dublin[2] Pharmacopœias have for many years been printed in the vernacular language; and the British Pharmacopœia, which has superseded the two last named, is published in English.

"There is an obvious advantage to the natives of a country in having a pharmacopœia in their mother-tongue; but, for the use of foreigners, the Latin language would be more convenient. Hence in some countries, as in Greece, the pharmacopœia is published in both Latin and the vernacular language. In the Pharmacopœia of the United States of America for 1831 this plan was adopted; but in the edition of this work published in 1842, and in subsequent editions, the English language has been exclusively employed" (Pereira's *Selecta è Præscriptis* (London, 1873).

"The ultimate object of lectures on Materia Medica is to teach the legitimate use of means to an end. The centre around which the lectures are grouped is the *Physician's prescription.* From the utmost verge of the subject, the thread upon which it hangs leads back to the prescription, not of drugs only, but of everything that can alleviate suffering and cure disease. The ultimate object of medical education is to teach *how to write a prescription*, and in that little act lies the severest test of a physician's attainments. To be examined upon a prescription is to give access to every department of medical learning. If the student could satisfactorily explain the *how, what, when,* and *why* of prescribing, his education would be complete; but this is not to be attained during his curriculum merely, it is what the practitioner is still learning at the close of his career. The practical application of all the medical sciences culminates in the prescription; the ultimate object of Chemistry, Botany, Physiology, Pathology, and the other allied sciences, with respect to medicine, is to teach the physician how to apply the remedies at his disposal most advantageously to his patients" (Dr Scoresby-Jackson's *Materia Medica*).

"Prescriptions are sometimes called *extemporaneous or magistral formulæ*, because they are constructed by the practitioner (*magister*) on the instant, *extempore.*"

"A medicinal formula, or a prescription, has been divided into four constituent parts, a plan which will be found to admit of useful application to practice, inasmuch as it is well calculated to point out the methods by which we may accomplish the objects investigated in the preceding pages, or, in the language of Asclepiades, by which we may enable the basis of our prescription to operate, *Cito, Tuto, et Jucunde;* quickly, safely, pleasantly, thus:—

I. The Basis; or principal ingredient (*Curare*).
II. The Adjuvans; that which assists and promotes its operation (*Cito*).
III. The Corrigens; that which corrects its operation (*Tuto*).
IV. The Constituens, diluent or vehicle; that which imparts an agreeable form (*Jucunde*).

"These several elements, however, are not all necessarily present in every formula, since many medicines do not require any addition to promote their operation; and the mild and tractable nature of others renders the introduction of any corrective unnecessary; while some, again, are in their nature so manageable as not to require the interposition of any vehicle or constituent" (Paris' *Pharmacologia*).

[1] *The Pharmacopœia of the Royal College of Physicians of Edinburgh.* Edinburgh, 1841. 12mo.

[2] *The Pharmacopœia of the King and Queen's College of Physicians in Ireland.* 1850.

"Many prescriptions contain but one or two ingredients, there being no special need of a corrective vehicle or diluent, the tendency of modern therapeutics being against polypharmacy, and in the direction of simple and concentrated remedies, or those having positive effects. There are many advantages to be derived, however, from the combination of ingredients, even when these have similar medicinal action" (*Remington*).

I. "*To promote the action of the basis or principal medicine.*

(1) By combining several different forms or preparations of the same substance, *e.g.*, as by prescribing together different galenical forms of the same drug, as the tincture and infusion or decoction; increasing the solubility of a drug by means of one of an allied nature—iodine with potassium iodide.

(2) By combining the basis with substances which are of the *same nature*, that is, which are individually capable of producing similar effects, but with less certainty or energy than when in combination with each other. *Pulvis Cinnamomi Compositus, Infusum Gentianæ Compositum*, and numerous other compound preparations of the pharmacopœia, are examples of such combination.

(3) By combining the *basis* with substances of a *different nature*, and which do not exert any chemical influence upon it, but are found by experience to be capable of rendering the stomach, or system, or any particular organ, more susceptible of its action; *Pulvis Antimonialis, Pulvis Jalapæ Compositus* constitute examples.

II. "*To correct the operation of the basis by obviating any unpleasant effects it might be likely to occasion, and which would prevent its intended action and defeat the objects of its exhibition.*

(1) By mechanically separating, or chemically neutralising, the offending ingredient.

(2) By adding some substance capable of *guarding the stomach or system* against its deleterious effects. *Examples.—Pilula Plumbi cum Opio;* the use of milk in *Mistura Scammonii; Pilula Colocynthidis et Hyoscyami.*

III. "*To obtain the joint operation of two or more medicines.*

(1) By combining those substances which are calculated to produce the *same ultimate effects*, although by totally different modes of operation. *Examples.*—The use of 'Magnesii Sulphas' in *Mistura 'Sennæ' Composita*, 'Opium' in *Pulvis 'Ipecacuanhæ' Compositus.*

(2) By combining medicines which have entirely different powers, and which are required to obviate different symptoms, or to answer different indications; *e.g.*, the use of aromatic stimulants with narcotics as exemplified in *Tinctura Camphoræ Composita, Confectio Opii*, and *Tinctura Opii Ammoniata.*

IV. "*To obtain a new and active remedy, not afforded by any single substance.*

(1) By associating medicines which excite different actions in the stomach and system; in consequence of which, *new*, or *modified*, results are produced. *Examples.—Pilula Hydrargyri Subchloridi Composita; Pulvis Ipecacuanhæ Compositus.*

(2) By combining substances which have the property of acting *chemically* upon each other; the result of which is the formation of *new compounds*, or the decomposition of one or more of the original ingredients, and the develop-

Extemporaneous Forms of Medicines.

	For Administration by the Mouth.	For External Use.[1]	For Special Methods of Application.
LIQUIDS.	1. **Misturæ,** or Mixtures proper (p. 193). Certain forms are termed :— (*a*) **Haustus,** or Draught. (*b*) **Solutio,** or Solution. (*c*) **Linctus,** or Linctus. (*d*) **Elixir,** or Elixir.	1. **Linimenta,** or Liniments (p. 226). 2. **Lotiones,** or Lotions (p. 226). 3. **Pigmenta,** or Paints (p. 228). 4. **Collodia,** or Collodions. 5. **Balnea,** or Baths.	1. **Gargarismata,** or Gargles (p. 216). 2. **Collyriæ,** or Eye-washes (p. 217). 3. **Guttæ,** or Drops for the Eyes (p. 217). 4. **Vapores,** or Inhalations (p. 218). 5. **Collunaria,** or Nasal Douches (p. 229). 6. **Injectiones,** or Injections (p. 218). 7. ,, Hypodermicæ (p. 219). 8. **Enemata,** or Clysters. 9. **Balnea,** or Baths.
SEMI-SOLIDS.	2. **Confectiones,** or Electuaries (p. 220). 3. **Capsulæ,** or Capsules (p. 209).	6. **Unguenta,** or Ointments (p. 228). 7. **Salve Mulls** (p. 228). 8. **Salve Sticks.** 9. **Plaster Mulls.** 10. **Vesicatoria,** or Blisters (p. 234). 11. **Emplastra,** or Plasters (p. 233). 12. **Cataplasmata,** or Poultices. 13. **Pastæ,** or Pastes (p. 233).	
SOLIDS.	4. **Pulveres,** or Powders (p. 221). 5. **Pilulæ,** or Pills (p. 222). 6. **Trochisci,** or Lozenges. 7. **Pastilli,** or Pastils (p. 233).		10. **Suppositoria,** or Suppositories (p. 229). 11. **Buginaria,** or Bougies (p. 233). 12. **Pessi,** or Pessaries (p. 233). 13. **Insufflationes,** or Insufflations.

[1] "These may be physiologically arranged under two classes, viz. :—1. Those, the effects of which are entirely *Local*, as exemplified in the application of certain Lotions, Cataplasms, Plasters, and Ointments. 2. Those which excite general effects, or produce an influence upon parts remote from the seat of application, as in the case of Blisters, and other counter-irritants ; and of Mercurial Ointments, Liniments, and Plasters, and Hot and Cold baths" (Paris' *Pharmacologia*).

ment of their more active elements. *Examples.*—The products formed in mixing a Seidlitz powder,[1] *Mistura Ferri Composita*, *Lotio Hydrargyri Flava*, and *Nigra*, Chlorine mixture (p. 211).

(3) By combining substances between which no other change is induced than a diminution, or increase, in the *solubilities* of those principles which are the repositories of their medicinal virtues.

V. " *To afford an eligible form.*

(1) By which the efficacy of the medicine is enhanced.

(2) By which its aspect or flavour is rendered less objectionable (*vide* Elixir).

(3) By which it is *preserved* from spontaneous decomposition, or any other chemical change. *Examples.*—*Ferri Carbonas Saccharata:* the use of Tinctura Cardamomi Composita in *Decoctum Aloes Compositum*" (abstracted from Paris' *Pharmacologia*).

The Dispensing Bench.—The following sketch (fig. 67) represents one-tenth (a length of 5 feet—space for two men) of a dispensing bench suitable for a class of twenty working at the same time; the height of the bench from the floor is 3 feet, the

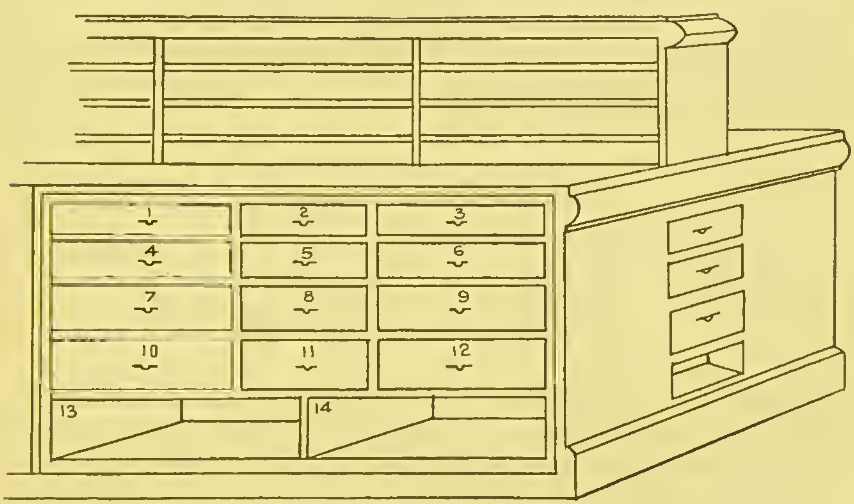


Fig. 67.

apparent back being a facsimile of the front; the whole being furnished with gas-supply and taps, to which Bunsen lamps may be adapted as required.

[1] A "Seidlitz powder" consists of two packages wrapped respectively in blue and white paper:—the former contains 2 drachms of *Soda Tartarata* and 2 scruples of *Sodium Bicarbonas*, the latter 36 grains of *Acidum Tartaricum*.

The drawers containing the necessary subdivisions may be arranged as follows :—

1. Pens, Ink, Blotting-Paper, Labels, Sealing-Wax, Envelopes.
2. Spatulas, Glass-Rods, Scissors, Plaster-Irons.
3. Same as (1).
4. Medicine Phials, Covered Pots, and Poison Bottles.
5. Corks, Pill and Powder Boxes, Muslin, Tow.
6. Same as (4).
7. Cut Paper, a Box of Hand-Scales with Weights.
8. Dusters and Cloths.
9. Same as (7).
10. A 5 gr. Pill Machine; Silver Leaf and Pot; Pill Finisher.
11. Miscellaneous (porcelain capsules and dishes, &c.).
12. Same as (10).

13 and 14. Slabs, Funnels, Mortars, Infusion Pots, Pint Kettle, Bunsen Burner, and Tripod.

Furthermore, the dispensary should be furnished with a water-supply and conveniently arranged sink, also with a pair of heavy scales, with weights up to 7 lbs.

Apothecaries' Weight.

Lat. nom. sing.					
(*Granum, i*),	20 Grains	= 1 Scruple	℈ =	20 grains.
(*Scrupulus, i*),	3 Scruples	= 1 Drachm	ʒ =	60	,,
(*Drachma, æ*),	8 Drachms	= 1 Ounce	℥ =	480	,,
(*Uncia, æ*),	12 Ounces	= 1 Pound (*libra*) ℔	=	5760	,,

The above are used solely in prescribing and in the dispensing of physicans' prescriptions. Whenever the terms *Drachm* (ʒ) and *Ounce* (℥) are applied to liquids, the Fluid Drachm and Fluid Ounce, as defined in the British Pharmacopœia, are understood respectively. [When parts are referred to, solids are to be taken by weight and liquids by fluid measure.]

Measures.—The measures used in dispensing are the lower denominations of the imperial pint (*vide* figs. 3, 4, 5, and 6). The measure of the fluid ounce is the capacity equal to the volume of one avoirdupois ounce (437·5 grains) of distilled water at the temperature of 60° Fahrenheit, and contains 480 minims.

Domestic Measures.—In writing the directions for the patient, as in the operation of labelling an extemporaneous preparation,

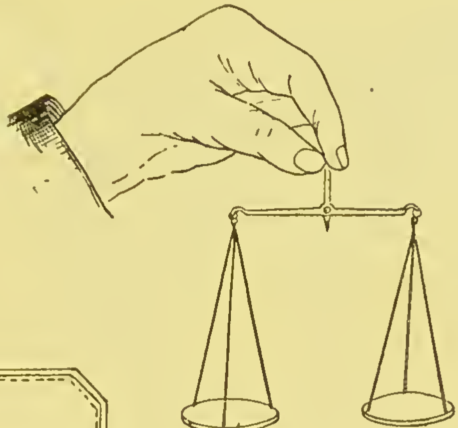


FIG. 68.—A pair of "hand-scales" (with glass pans) for dispensing purposes (for very delicate operations, use balance fig. 9).

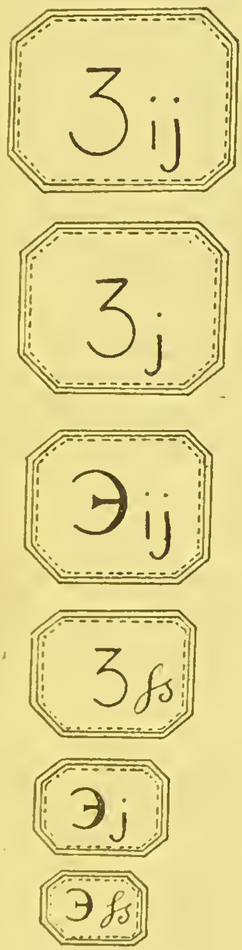


FIG. 69.—A set of drachm weights (of brass) 2 dr., 1 dr., 2 sc., ½ dr., 1 sc., ½ sc.

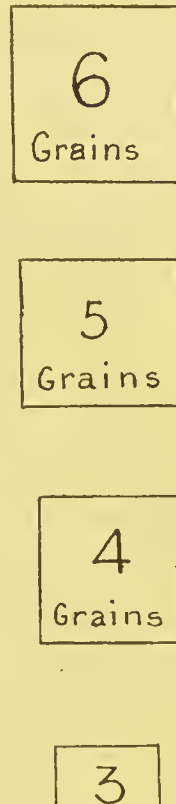


FIG. 70.—A set of grain weights (platinum or aluminium foil).

it is not customary to use the terms "drachm," "ounce," &c., for the simple reason that they would not generally be understood, or, if they were, they would probably cause inconvenience. Upon that account it is preferable to use the household terms "tablespoonful," "teaspoonful," &c., as being approximate quantities familiar to every one, although, inasmuch as spoons of the same denomination vary considerably in capacity, it is probably advisable in practice to resort to the use of a graduated medicine-glass (fig. 71). The Latin for a "spoonful" is *cochleare*, a third declension substantive.

When the abbreviations ʒ and ℥ occur in that part

of a prescription devoted to the directions for the patient, they are to be interpreted as follows :—

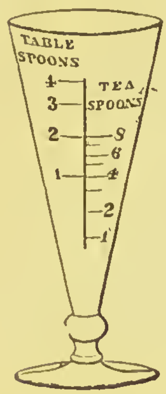


FIG. 71.—Graduated medicine-glass.

ʒj. = 1 teaspoonful (*Cochleare minimum*).
ʒij. = 2 teaspoonfuls (*Cochlearia minima duo*), or 1 dessert-spoonful (*Cochleare medium*).
ʒiij. = 3 teaspoonfuls (*Cochlearia minima tria*).
℥ss. = 1 tablespoonful (*Cochleare magnum*).
℥j. = 2 tablespoonfuls (*Cochlearia magna duo*).
℥jss. = A wine-glassful (*Cyathus vinarius*).

Incompatibility. — According to Jacob Bell (*Pharm. Jour.*, 1844), "the term *incompatible* is used in reference to substances which cannot be mixed without decomposition and change of properties taking place, but it does not necessarily follow that such combinations should never be made. There are many instances in which very efficient remedies are produced by the mixture of substances which thereupon lose their original characters; but it sometimes happens that in this manner changes are effected which were not contemplated by the prescriber, and which are attended with results which would not, *à priori*, have been anticipated."[1]

Incompatibility is of three kinds—(1) *Chemical*, that is, accompanied with chemical change, *e.g.*, salts of iron with tannin and astringent substances; (2) *Physical*, *e.g.*, fixed oils and water; (3) *Therapeutical*, *e.g.*, antagonistic substances, like Belladonna and Calabar bean.

In the dispensing of all incompatible substances (*e.g.*, *Liq. Arsenicalis* and *Liq. Ferri Dialysat.*, which are frequently prescribed together), there is a rule among dispensers to prevent anticipated chemical change by keeping incompatibles as far apart as possible thus—by diluting each respectively with the common aqueous or other vehicle before mixing them together. This subject will be referred to again (p. 214).

[1] *Berthollet's Laws.*—I. Two bodies, in solution, will mutually decompose each other, if it be possible, by double decomposition (*i.e.*, mutual exchange of corresponding radicals), to produce a new body less soluble than either of the two original substances. II. Two bodies, when heated together, will mutually decompose each other, if it be possible, by double decomposition, to produce a new body more volatile than either of the two original substances. [I. Evidently applies to precipitation. II. To sublimation and distillation.] "The art of prescribing, it must be admitted, is not a subject coming precisely within the province of the pharmacist, yet the pharmacist is necessarily acquainted with the methods of prescribing which are prevalent, and is more capable than any other person of judging of the merits of formulæ under pharmaceutical and chemical aspects" (Hanbury, *Science Papers*).

Ambiguity.—The prescriber should avoid this, not only as regards careless autograph,[1] but also as regards doubtful nomenclature, which in some instances, by having been wrongly interpreted by the dispenser, has resulted in serious mischief to patients. The following represent some of the more frequently occurring ambiguously abbreviated terms :—

Acid. Hydroc.	Acidum Hydrochloricum ? or Acidum Hydrocyanicum ?
Aconit.	Aconitine ? Aconiti Radix ? Aconiti Folia ?
Ammon.	Ammonia (alkali) ? Ammoniacum (gum resin) ?
Aq. Chlor.	Aqua Chlori ? Aqua Chloroformi ?
Aq. Menth.	Aq. Menth. Pip. ? Aq. Menth. Sativ. ?
Calc. Chlor.	Chloride of Calcium ? Chlorinated Lime ?
Chlor.	Chlorine ? Chloroform ? Chloral ?
Ext. Col.	Extractum Colchici ? Extractum Colocynthidis ?
Hyd. Chlor.	Calomel ? Corrosive Sublimate ? Chloral Hydrate ?
Hyd.	Hydrargyrum ? Hydras ? Hydriodas ? Hydrochloras ? Hydrocyanicus ?
Mag. Carb. Magnesia	Pond. or Levis ?
Mist. Ammon.	Ammonia mixture ? Mixture of Ammoniacum ?
Potass. Hyd.	Hydrate of Potash ? Hydriodate of Potash ? (iodide of potassium).
Sod. Hypo.	Hyposulphite of sodium ? Hypophosphite of sodium ?
Sod. Sulp.	Sulphate of Sodium ? Sulphite ? Sulphide ?
Sulp.	Sulphur ? Sulphide ? Sulphate ? Sulphite ?
Zinci Phosph.	Phosphate of Zinc ? Phosphide of Zinc ?

Where possible the nomenclature of the *Brit. Pharm.* should be used, otherwise the source of compound prescribed should be stated in brackets, *e.g.*, Tinct. Catechu Co. [Ph. L.] ℥j.

As regards dosage, especially of a potent drug, if much above

[1] "The almost indecipherable handwriting of some prescribers is often a source of considerable difficulty, and if it were not for the care exercised by dispensers, it might be a cause of more serious mischief. *The Medical Press and Circular* refers to a recent case in which a firm was subjected to heavy damages for a mistake in dispensing, though no blame could be attached to any person but the prescriber, who ordered a harmless drug, but wrote the name so badly and carelessly, that any person not knowing what he wished to convey, would have read the words as they were read by the dispenser. Our contemporary remarks, that it is an opprobrium to medicine that physicians will endanger life by neglect of the commonest precautions, and that although they may be very explicit in their directions to the nurse and the patient, they are too often criminally negligent in their directions to the dispenser" (*Pharm. Jour. and Trans.*, Jan. 11, 1890).

the pharmacopœial maximum be prescribed, attention should be drawn to it with an ! lest the dispenser refuse to compound the prescription.

The use of "**ad.**"—The respective presence or absence of this term in conjunction with the vehicle or diluent of any extemporaneous preparation materially affects not only the volume of the resulting product, but the proper regulation of its division into doses.

Observe the construction of the following formulæ :—

No. 1.

℞ Liq. Hydrarg. Perchl., ℥jss.
Syrupi, . . . ℥ij.
Aquæ, . . ad ℥iv.
M. ft. mist.
A dessertspoonful three times a day.

No. 2.

℞ Liq. Hydrarg. Perchl., ℥jss.
Syrupi, . . . ℥ij.
Aquæ, . . . ℥iv.
M. ft. mist.
A dessertspoonful three times a day.

No. 1 would be dispensed as written, viz., as a 4-ounce mixture (containing sixteen doses).

No. 2 would be dispensed as written, viz., as a $7\frac{1}{2}$-ounce mixture (containing thirty doses).

It is therefore preferable to always use the term "ad," as its presence immediately defines the ultimate volume intended, and prevents any mistake as to regulation of dose.

The most convenient ultimate sizes of liquid preparations, *e.g.*, misturæ, lotiones, &c., are either 3, 4, 6, 8, 10, or 12 fluid ounces (medicine phials being generally cast in these sizes); $1\frac{1}{2}$ oz. or 2 oz. phials for "draughts."

The use of **semis.**—In designating the quantities of ingredients in prescriptions, it is often requisite to use the abbreviation *ss* or *ſs* ; turn to prescriptions, Type III. *e.* (*Muc. Acaciæ*), and Type I. *c.* (*Aq.*), the student should observe that the same abbreviation *ss* is used, whether the "half" in question be a substantive (*semis*) or an adjective (*dimidius*).

The use of **ana** (Greek).—The abbreviation *aa* means "of each." (*cf.* Type I. *c.* and III. *a.*)

The use of **aqua.**—In dispensing prescriptions *aqua* should be understood to mean distilled water (*Brit. Pharm.*).

Misturæ.

"The term *mixture* is at present applied to those preparations in which different ingredients are mingled together in the liquid form, or in which solid substances are diffused through liquids, and suspended in them by the medium of mucilage or syrup. It consequently includes those subordinate forms which were distinguished by the older writers by the terms *emulsions*, &c.

"In prescribing extemporaneous mixtures, the following general rules must be observed :—

"I. Substances which are disposed to enter into chemical union, or to decompose each other, ought not to be mixed together, unless it be with a view to obtain the new products as a remedy.

"II. Transparency is not a necessary condition, and hence insoluble powders may be introduced into a mixture, provided that the following precautions be observed :—

"(1) They must be divisible, and mechanically diffusible in the liquid.

"(2) They must not possess too great a specific gravity.

"(3) They must not render the liquid too mucilaginous or thick, thus, ℥j should seldom hold suspended more than ʒss of a vegetable powder, ℈ij of an electuary or conserve, or ℈j of an extract.

"III. The taste, the colour, and the general aspect of the mixture should be rendered as agreeable as possible. A draught differs merely from a mixture as to quantity ; it is usually taken at once, and should not exceed ℥iss. It is to be preferred to a mixture when

"(1) The remedy is to be taken in a precise dose.

"(2) Whenever it is readily liable to spontaneous decomposition, or to be speedily affected by the action of the air.

"In apportioning the dose of a mixture, the following proportions may be considered as sufficiently accurate approximations:—A tablespoonful, *cochleare amplum*, ℥ss ; dessertspoonful, *c. mediocre*, ʒij ; teaspoonful, *c. minimum*, ʒi ; a wine-glassful (*cyathus*), although very variable, may be estimated as ℥iss. The custom of measuring the dose of a liquid by dropping from the mouth of a phial is necessarily very inaccurate, and since the force of cohesion varies in different liquids, as it does in solids, the size of their respective drops must vary accordingly. It will, therefore, be always advisable to dilute an active medicine that is to be so apportioned with at least a treble quantity of water or spirit, that its real dose may not be essentially altered by any slight alteration in the quantity" (*Pharmacologia*, J. A. Paris).

A "mixture" is, consequently, a liquid extemporaneous preparation intended to be administered in a number of separate doses.

For purposes of theoretical and practical instruction in the philosophy of extemporaneously combining drugs for medicinal use, the student, under the personal direction of a qualified teacher, may work through the following **types**, *which have been selected, from the formulæ of the various* **Pharmacopœias of the London Hospitals.**

Type I. The simplest Form of Mixture, consisting of the admixture of Liquids readily miscible with each other.

Dispense the following prescriptions : [1]—

(*a*).[2]

Elizabeth Tyler.

℞. Vin. Ipecac. ʒj.
Ac. Hydrocyan. Dil. ♏ viij.
Syrup. ʒiij.
Aq. Anethi ad ℥iv.
M. Ft. mist.
Capt. ʒij. omn. 3ta hor. vel tuss. urg.

Feb. 1, 89. A. B. C.

Lat.—Recipe, Vini Ipecacuanhæ drachmam unam, Acidi Hydrocyanici Diluti minima octo, Syrupi drachmas tres, Aquæ Anethi ad uncias quattuor. Misce, fiat mistura. Capiat drachmas duas omni tertia hora vel tussi urgente.

Eng.—Take of Ipecacuanha wine 1 drachm, of Diluted Hydrocyanic acid 8 minims, of Syrup 3 drachms, of Dill water to the volume of (make up to the volume of) 4 ounces. Mix, let a mixture be made. A dessertspoonful to be taken every third hour, or when the cough is troublesome.

Observations.—Volatile ingredients like Acid. Hydrocyan. dil. it is customary to add last. Observe the manner in which the *quantities* of the medicinal ingredients in the above prescription have been arrived at. Each " dose " contains of Ipecacuanha Wine $3\frac{3}{4}$ minims, Diluted Hydrocyanic Acid $\frac{1}{2}$ minim, Syrup about 11 minims; now the phial contains 16 doses, therefore the " quantities " constitute the product of the above numbers multiplied by 16.

Again, every prescription necessarily consists of four parts—(1) Recipe, called the *superscription.* (2) The ingredients and quantities, called the *inscription.* (3) The directions to the dispenser, how to deal with the ingredients (M. ft. mist.), the *subscription.* (4) The directions to the patient, how to use the

[1] The amount of work to be undertaken in one lesson (1 hour) to be regulated by the demonstrator.

[2] Mistura pro Pertussi (*St Mary's*). (For Vocabulary, see "Appendix.")

N.B.—See the requirements of the Pharmacy Act, 1868, as regards the Dispensing of Poisons (Appendix).

medicine, called the *signature* (from the L. "Signetur," let it be entitled or labelled).

Observe, also, that all the quantities are in the accusative case, governed by the verb Recipe, and that all the ingredients are in the genitive.

(*b*).[1]

Mr Wilson.

R. Tr. Ferri Perchl. ʒj.
Acid. Nit. Dil. ʒiss.
Syrup. ʒij.
Inf. Quass. ad ℥vj.
M. Ft. mist.
Cochl. mag. ij. *ter die sd.*

Feb. 5, 88. *D. E. F.*

Lat.—Recipe, Tincturæ Ferri Perchloridi drachmam unam, Acidi Nitrici Diluti drachmam unam cum semisse, Syrupi drachmas duas, Infusi Quassiæ ad uncias sex. Misce, fiat mistura. Cochlearia magna duo ter die sumenda.

Eng.—Take of Tincture of Perchloride of Iron 1 drachm, of Diluted Nitric acid 1 drachm and a half, of Syrup 2 drachms, of Infusion of Quassia to (the volume of) 6 ounces. Mix, let a mixture be made. Two tablespoonfuls to be taken three times a day.

Observations.—Quassia and Calumba, unlike most other bitter vegetable drugs, contain no tannin or other astringent substances, which yield inky precipitates with salts of iron.

(*c*).[2]

Mr C. Smith.

R. Vin. Ipecac.
Ox. Scillae aa ʒiv.
Aq. ad ℥iss.
M. Ft. haust.
Statim sumend.

Mar. 10, 84. *G. H. I.*

[1] Mistura Chalybeata (*St Thomas's*).
[2] Haustus Emeticus (*St Bartholomew's*).

Lat.—Recipe, Vini Ipecacuanhæ, Oxymellis Scillæ ana drachmas quattuor, Aquæ ad unciam unam cum semisse. Misce, fiat haustus, statim sumendus.

Eng.—Take of Ipecacuanha Wine, of Oxymel of Squill, of each 4 drachms, of Water to an ounce and a half. Mix, let a draught be made. To be taken immediately.

Observations.—Oxymel and Syrup of Squill (they containing free acetic acid) have been prescribed sometimes with carbonates and alkalis, Sp. Ammon. Aromat. &c.; such erroneous combinations are necessarily incompatible.

Type II. The Admixture of soluble Salts and Solids with aqueous Vehicles.

(*a*).[1]

Mrs Langley.

℞. *Quinin. Sulphat.*
Ferri Sulph. aa gr. vj.
Mag. Sulph. ʒiss.
Acid. Sulph. Dil. ♏ xv.
Aq. *ad* ℥vi.
M. Ft. mistura.
℥j. *4tis horis sumend.*

Mar. 15, 86. *J. K. L.*

Lat.—Recipe, Quininæ Sulphatis, Ferri Sulphatis ana grana sex, Magnesii Sulphatis drachmam unam cum semisse, Acidi Sulphurici Diluti minima quindecim, Aquæ ad uncias sex. Misce, fiat mistura, uncia una quartis horis sumenda.

Eng.—Take of Quinine Sulphate, of Iron Sulphate of each 6 grains, of Magnesium Sulphate a drachm and a half, of Diluted Sulphuric Acid 15 minims, of Water to volume of 6 ounces. Mix, let a mixture be made. Two tablespoonfuls to be taken every four hours.

Observations.—The second and third ingredients are freely soluble in water; quinine sulphate only 1 in 800; the addition of the H_2SO_4 (a judicious addition in sulphate of quinine mixtures, unless its suspension be provided for) converts quinine sulphate

[1] Mistura Quininæ c. Ferro (*Westminster Ophthalmic*).

into the bisulphate, which latter is soluble 1 in 12. (Quinine hydrochlorate 1 in 40.)

As regards soluble salts, however, there is a great difference in the rapidity with which they dissolve; salts known to be positively deliquescent may be added direct to the phial; with others, especially when crystalline or in lumps, it is advisable to use the mixture mortar wherewith to crush the larger crystals to powder, and afterwards to add the water to them; indeed, a supply of boiling distilled water should always be readily accessible to dispensers, its judicious use in sparing quantities saving much time and labour; for sparingly soluble salts such as potassium chlorate, gallic acid and others, hot water however must not be used, since the solutions of such bodies in excessive amount crystallise out again on cooling; neither should hot water be used if the mixture contain any spiritous or other volatile ingredients, unless the liquid product be cooled before adding them.

Astringent infusions and decoctions (*e.g.*, Inf. Rosæ Acid.) form with quinine insoluble precipitates (tannates); the acetates and soluble alkaline salicylates likewise precipitate it as acetate and salicylate respectively. Liquid extract of liquorice has been used to mask its flavour; no free mineral acid must be present, however, in the mixture, or the extract will be precipitated. Indeed, all crystalline substances (*e.g.*, Potassii Chloras, Quininæ Sulphas, &c.), unless extremely soluble, should be reduced to powder by trituration in the mixture mortar, and there diluted with water, previous to introducing into the phial.

(*b*).[1]

Mr Evans

℞. Quinin. Sulph. gr. viij.
Tr. Ferri Perchl. ♏ 80.
Sp. Chlorof. ʒj.
Aq. ad ℥vj.
M. Ft. mist.
Cap. cyath. vinar. ter die.

Lat.—Recipe, Quininæ Sulphatis grana octo, Tincturæ Ferri Perchloridi minima octoginta, Spiritus Chloroformi drachmam

[1] Haustus Ferri et Quininæ (*Fever Hosp.*).

unam, Aquæ ad uncias sex. Misce, fiat mistura. Capiat cyathum vinarium ter die.

Eng.—Take of Sulphate of Quinine 8 grains, of Tincture of Perchloride of Iron 80 minims, of Spirit of Chloroform 1 drachm, of Water to 6 ounces. Mix, let a mixture be made. A wine-glassful to be taken three times a day.

Observations.—Tincture of Perchloride of Iron is sufficiently acid to dissolve the quinine; as in the preceding prescription it is customary to dilute the quantity of acid liquid with water, adding (in the measure-glass) the quinine, with use of a glass rod. Mucilage of acacia is precipitated by perchloride of iron.

(*c*).[1]

Mr Grantham

℞. Tr. Aconit. ♏ 24.
Vin. Colch. ♏ 160.
Pot. Bicarb. gr. 80.
Aq. ad ℥viij.
M. Ft. mist.
Cap. ℥j. ter die.

June 5, 85. A. B. C.

Lat.—Recipe, Tincturæ Aconiti minima viginti quattuor, Vini Colchici minima centum sexaginta, Potassii Bicarbonatis grana octoginta, Aquæ ad uncias octo. Misce, fiat mistura. Capiat unciam unam ter die.

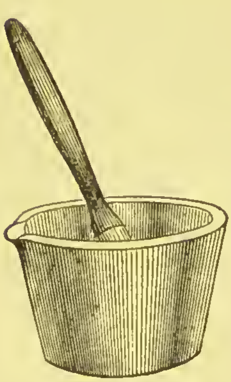


Fig. 72.—A mixture mortar.

Eng.—Tincture of Aconite 24 minims, Colchicum Wine 160 minims, Bicarbonate of Potassium 80 grains, Water to 8 ounces. Mix, let a mixture be made. Two tablespoonfuls to be taken three times a day.

Observations.—Mineral salts should be dissolved in water previous to the addition to them of spiritous solutions; the latter, in large amounts, as a rule precipitate them from aqueous solution.

[1] Mistura Aconiti c. Colchico (*Westminster Ophth.*).

The following prescription is identical with the above, but written in another way.

(*cc*).

Mr Grantham.

℞. Tr. Aconiti ♏ iij.
Vin. Colch. ♏ xx.
Pot. Bicarb. gr x.
Aq. ad ℥j.
M. t. d. s.
Mitte ℥viij.

A. B. C.

(*d*).[1]

Mr W. Smith.

℞. Hydrarg. Bichlorid. gr. xv.
Acid. Arsenios. gr. iv.
Acid. Hydrochl. ♏ xv.
Aq. ferventis ad ℥j.
Coque ut acd. arsenios. liqueft.
Sign. "Solutio."
♏ iij. *ad* x. *ex. aqua sumend.*

Lat.—Recipe, Hydrargyri Bichloridi grana quindecim, Acidi Arseniosi grana quattuor, Acidi Hydrochlorici minima quindecim, Aquæ ferventis ad unciam unam. Coque ut acidum arseniosum liquefiat. Signetur solutio; minima tria ad decem ex aqua sumenda.

Eng.—Take of Perchloride of Mercury 15 grains, Arsenious Acid 4 grains, Hydrochloric Acid (not the "diluted") 15 minims, Boiling water to 1 ounce. Boil until the arsenic is dissolved. Label, "The solution." 3 to 10 minims to be taken in water.

Observations.—The liquid form is probably preferable for very poisonous drugs like arsenic, strychnine, morphine, and the like, since the accurate regulation of the dose is more readily facilitated.

[1] Solutio Hydrargyri Composita (*Skin Hosp.*).

The pharmaeopœial "alkaline" solution of arsenic (*Liq. Arsenicalis*) is incompatible with *Liq. Hydrarg. Perchl.*, Ph.B.

Effect solution of the above in a small glass flask.

Such concentrated solutions as the above, including strong tinctures, &c., are sometimes prescribed under the term "Guttæ." The majority of the guttæ of the Pharmaeopœias of the London hospitals have reference, however, to preparations intended to be applied to the eyes (*oculis instillandæ*), and, in dental formulæ, to the teeth.

Type III. The Admixture of Insoluble Solids with Aqueous Vehicles. The Admixture of Liquids resulting in the Production of Insoluble Solids. Provision for their temporary suspension by increasing the viscosity of the liquid (by the addition of gums, mucilages, syrups, &c.), thus facilitating the regulation of the dose.

(*a*)[1]

Miss Annesley.

℞. Pulv. Cinnam. Co.
Pulv. Acaciae.
Pulv. Cret. Praep. aa gr. xl.
Tinct. Opii. ♏ xx.
Aq. ad ℥iv.
M. Ft. mist.
Capt. part. quart. p. r. n.

Lat.—Recipe, Pulveris Cinnamomi Compositi, Pulveris Acaciæ, Pulveris Cretæ Præparatæ ana grana quadraginta, Tincturæ Opii minima viginti, Aquæ ad uncias quattuor. Misce, fiat mistura. Capiat partem quartam pro re nata.

Eng.—Take of Compound Powder of Cinnamon, Acacia in powder, Prepared Chalk in powder of each 40 grains, Tincture of Opium 20 minims, Water to amount of four ounces. Mix, let a mixture be made. A fourth part to be taken when required.

Observations.—Use the mixture mortar. Such mixtures require a "shake the bottle" label.

[1] Mistura Cretæ Aromat. Anodyna (*London Ophth.*).

(*b*).[1]

Mr Fairweather.

R. Bismuth. Subcarb.
Magnes. Carb. Pon. aa ʒj.
Pulv. Tragac. Co. ʒj. ℈ij.
Aquae ad ℥vj.
M. Ft. mist.
Sumat ℥j. *ter quaterve die.*

July 21, 88. *G. H.*

Lat.—Recipe, Bismuthi Subcarbonatis, Magncsii Carbonatis ponderosæ ana drachmam unam, Pulveris Tragacanthæ Compositi drachmam unam et scrupulos duos, Aquæ ad uncias sex. Misce, fiat mistura. Sumat unciam unam ter quartcrve dic.

Eng.—Take of Subcarbonate of Bismuth, Heavy Carbonate of Magncsia, of each one drachm, of Compound Powder of Tragacanth one dracham two scruples, of Water to volume of six ounces. Mix, lct a mixture be made. Two tablespoonfuls to be taken three or four times a day.

Observations.—The "subnitratc" of bismuth is frcquently prescribed with carbonatcs; if such bc dispensed with cold water, a slow evolution of carbonic acid ensues, bursting the medicine bottlc if securely corked :—*e.g.*, $2BiONO_3 + 2NaHCO_3 = Bi_2O_2CO_3 + 2NaNO_3 + H_2O + CO_2$. To prevent this occurring, complcte decomposition may bc quickly effccted by trcating the *two* substances with $\frac{3}{4}$ oz. of boiling distilled water in the mixturc mortar, and proceeding in the usual manner.

(*c*).[2]

G. Martin, Esq.

R. Guaiaci Res.
Sacch. Alb. aa gr. 64.
P. Gum. Acac. gr. 32.
Aq. Cinnam. ad ℥vj.
M. Ft. mist.
Cap. ℥ss.. *bis. vel ter die inter cibos.*

Mar. 16, 70. *K. L. M.*

[1] Mistura Bismuthi (*University Coll.*). [2] Mistura Guaiaci (*Ph. B.*).

Lat.—Recipe, Guaiaci Resinæ, Sacchari Albi ana grana sexaginta quattuor, Pulveris Gummi Acaciæ grana triginta duo, Aquæ Cinnamomi ad uncias sex. Misce, fiat mistura. Capiat unciam dimidiam bis vel ter die inter cibos.

Eng.—Take of Guaiacum, of White Sugar of each 64 grains, of Gum Acacia in powder 32 grains, of Cinnamon Water to six ounces. Mix, let a mixture be made. A tablespoonful to be taken two or three times a day between meals.

Observations.—When resins and gum-resins are directed to be used in the preparation of mixtures, the natural products in tears or lumps are intended, unless otherwise ordered: confer (*Brit. Pharm.*) *Misturæ Guaiaci*, *Ammoniaci*, and *Ferri Co.* The reason of this is, that the ready-made impalpable powders of such drugs have probably been dried by the application of heat previous to their pulverization, and thus some of their volatile constituents may have been dissipated or other constituents probably altered by the treatment. Oxidising agents and organic matter change the colour of Mist. Guaiaci in various ways, producing blue, green, and brown colorations (*e.g.*, confer *Brit. Pharm.*—The testing of Scammoniæ Resina: "its tincture does not render the fresh-cut surface of a potatoe '*blue*,'" indicating absence of Guaiacum).

(*d*).[1]

A. B. Graves.

℞. Tr. Benz. Co. ♏ 80.
Mell. Depur. ʒiij.
Aq. ad ℥iv.
M. Ft. mist.
Capt. cochl. mag. j. secund. qq. hora.

July 20, 78. Y. Z.

Lat.—Recipe, Tincturæ Benzoini Compositæ minima octoginta, Mellis Depurati drachmas tres, Aquæ ad uncias quattuor. Misce, fiat mistura. Capiat cochleare magnum unum secunda quaque hora.

Eng.—Take of Compound Tincture of Benzoin 80 minims, Clarified Honey three drachms, Water to four ounces. Mix, let a mixture be made. A tablespoonful to be taken every two hours.

[1] Mistura Benzoini (*Consumption Hosp.*).

Observations.—Complete the compounding of such mixtures by adding the resinous tinctures last, with immediate agitation. Confer *Brit. Pharm.* (process for preparing Podophylli Resina).

(*e*).[1]

Miss Somerville.

R. Tinct. Tolutan. ♏ *40.*
Tinct. Campl. Co. ʒij.
Muc. Acaciae. ℥ss.
Aq. *ad* ℥iv.
M.
Cap. coch. ij. *ampl. ter in die.*
Jan. 15, 70. *S. T.*

Lat.—Recipe, Tincturæ Tolutanæ minima quadraginta, Tincturæ Camphoræ Compositæ drachmas duas, Mucilaginis Acaciæ unciam dimidiam, Aquæ ad uncias quattuor. Misce. Capiat cochlearia duo ampla ter in die.

Eng.—Take of Tincture of Tolu 40 minims, of Compound Tincture of Camphor two drachms, of Mucilage of Acacia half an ounce, Water to ultimate volume of four ounces. Mix. Two tablespoonfuls to be taken three times a day.

Observations.—Remember that spiritous liquids added to undiluted mucilages precipitate the gum. That rectified spirit should be directed to be used in the preparation of a pharmacopœial mucilage (viz., Muc. Tragacanthæ, confer *Brit. Pharm.*) may indeed on this account appear to the student an anomaly. There is a difference, however, between the results of adding rectified spirit to mucilage and to dry impalpably powdered gums ; in the former case it precipitates the gum in the form of a clot requiring frequently some time to redissolve in water, in the latter case the impalpably powdered particles of gum are rendered sufficiently temporarily insoluble to allow of their being freely disseminated throughout an aqueous liquid added with brisk agitation (as in preparing Muc. Tragacanthæ), thus producing a homogeneous mucilage, otherwise not immediately obtainable. Observe that Muc. Tragacanthæ contains six grains of powdered gum to the fluid ounce, and that when such, or the powdered "gum tragacanth," is

[1] Mistura Tolutani (*Consumption Hosp.*).

ordered in a prescription already containing a not over-resinous rectified spirit tincture or spirit (*e.g.*, Sp. Chloroformi), such may conveniently be used for the purpose of distributing the gum instead of any additional rectified spirit. Powdered acacia ordered in a mixture containing spiritous liquids may be treated like powdered tragacanth, provided the resulting mucilage be not intended for emulsification purposes.

(*f*).[1]

Mr Somerville.

℞. *Oxymel Scillae.* ℥j.
Tinct. Tolut. ♏ 8*d.*
Tr. Camph. Co. ʒij.
Aq. *ad* ℥ij.
M. Ft. Linctus.
Cap. coch. med. j. *s.o.s.*

Feb. 15, 80. *W. K.*

Observations.—Extend the above into unabbreviated Latin.

Linctus.—"The Linctus differs principally from an electuary in being more liquid, and from a syrup in being of a thicker consistence. Its chief value consists in being from time to time introduced into the mouth, and gradually swallowed, by which the local influence of the medicine is protracted. In coughs, hoarseness, relaxed and sore throat, and other affections, its operation is obvious" (Paris' *Pharmacologia*).

Elixir.—An Elixir is a form of "mixture" having for its diluent or vehicle an aqueous dilution of an agreeable and palatable combination, known as—

Elixir Simplex:—

Oil of Bitter Orange, 30 minims.
Rectified Spirit, . 6 ounces.

Dissolve and add:—

Distilled Cinnamon Water, 7 ounces.
Syrup, ... 7 ounces.

Mix, filter through paper moistened with proof spirit and well

[1] Linctus Scillæ (*St Mary's*).

sprinkled with kaolin, returning the first portions of filtrate until it passes through bright.

Dose, 20 minims to a drachm—which may be added to the ounce of any liquid medicine.

(*g*).[1]

G. Marples, Esq.

R.	*Quinin. Sulphat.*	*gr.* xij.
	Ammon. Carbonat.	*gr.* xviij.
	Potass. Bicarb.	ʒij.
	Pulv. Acaciae.	ʒj.
	Aq.	*ad* ℥vj.
M.	*Ft. mist. s.a.*	
	℥j. *ter die sumend.*	

Nov. 10, 84. *A. B.*

Lat.—Recipe, Quininæ Sulphatis grana duodecim, Ammonii Carbonatis grana duodeviginti, Potassii Bicarbonatis drachmas duas, Pulveris Acaciæ drachmam unam, Aquæ ad uncias sex. Misce, fiat mistura secundum artem. Uncia una ter die sumenda.

Eng.—Take of Sulphate of Quinine 12 grains, of Carbonate of Ammonium 18 grains, of Bicarbonate of Potassium 2 drachms, of Acacia in powder 1 drachm, of Water to six ounces. Mix, let a mixture be made in the proper manner. Two tablespoonfuls to be taken three times a day.

Type IV. The Admixture of Refractory Natural Solid Substances with Water in such a manner as to produce Natural Emulsions.

(*a*).

Take three or four sweet almonds,[2] scald them in a mortar with boiling water for two minutes, dry them with a cloth, remove the thin brown seed-coats, place the ("blanched") almonds in a dry mortar, lightly crush and triturate to a coarse powder or paste;

[1] Mistura Quininæ Alkalina (*Charing Cross*).

[2] The proximate constituents of the sweet almond are—about 50 per cent. *fixed oil*, about 9 per cent. of *mucilaginous matter* and *sugar*, 25 per cent. of *albuminous matters* (including *emulsin*) soluble in water.

continuing the trituration, dilute with water (added in small quantities at a time) to the volume of 2 or 3 fluid ounces, and strain the liquid through muslin. The strained liquid is an "emulsion proper," that is, it is a mechanical mixture of finely divided oil-globules suspended in a mucilaginous or albuminous liquid, possessing the appearance of milk; like ordinary milk (which indeed is the most typical emulsion), if set aside for any length of time, the fatty particles tend to float to the surface. To the finished emulsion add 2 drachms of *Acidum Nitricum Dilutum;* observe that the emulsive character of the preparation is thus destroyed. Emulsions proper are coagulated by acids, undue proportions of metallic salts and spiritous liquids. Substances which promote the production of emulsions are termed *emulsive agents;* tinctures of quillaia and senega are used as such, but their products (when they are used alone), do not possess the desired stability. In general terms, therefore, emulsions are aqueous liquids of milky appearance, containing in suspension insoluble substances of very variable nature, such as liquid or solid fats, resinous matter, oleo-resins or essential oils.

(*b*).[1]

Mr J. Robinson.

R. G. Ammoniaci gr. 80.
Tr. Camph. Co. ʒiij.
Oxy. Scillae. ʒiij.
Aq. ad ℥vj.
M. Ft. mist.
Coch. mag. ij. ter die sumend.

April 3, 87. C. D.

Lat.—Recipe, Gummi Ammoniaci grana octoginta, Tincturæ Camphoræ Compositæ drachmas tres, Oxymellis Scillæ drachmas tres, Aquæ ad uncias sex. Misce, fiat mistura. Cochlearia magna duo ter die sumenda.

Eng.—Take of Ammoniacum eighty grains, Compound Tincture of Camphor three drachms, Oxymel of Squills three drachms, Water to six ounces. Mix, let a mixture be made. Two tablespoonfuls to be taken three times a day.

Observations.—Coarsely powder the ammoniacum and triturate with a little water into a thin paste; gradually add more water

[1] Mistura Ammoniaci Co. (*Consumption Hosp.*).

until the mixture assumes a uniform milky appearance, then strain through muslin; the strained liquid constitutes a natural emulsion; all gum-resins thus treated yield "natural emulsions"; being non-albuminous, they are not precipitated by the addition of weak acids. Never pour into the mixture-mortar spirits, tinctures, or volatile substances, unless so directed.

The following are the pharmacopœial gum-resins;—*Ammoniacum, Asafœtida, Cambogia, Galbanum, Myrrha, Scammonium;* they are natural exudations, composed of gum, resin, and generally essential oil. When rubbed with water the gum dissolves, the finely divided resin remaining mechanically suspended in the solution.

(*c*).[1]

Miss Baxendale.

℞. *Ferri Sulph.* *gr.* xv.
G. Myrrh. *gr.* xxx.
Pot. Bicarb. *gr.* xviij.
P. Sacch. Alb. *gr.* xxxvj.
Aq. *ad* ℥vj.
M. *Ft. mist.*
Cujus. cap. ℥j. *quartis horis.*

Aug. 15, 89. *L. M.*

Lat.—Recipe, Ferri Sulphatis grana quindecim, Gummi Myrrhæ grana triginta, Potassii Bicarbonatis grana duodeviginti, Pulveris Sacchari Albi grana triginta sex. Aquæ ad uncias sex. Misce, fiat mistura, cujus capiat unciam unam quartis horis.

Eng.—Two tablespoonfuls to be taken every four hours.

Observations.—Reduce the myrrh to powder, add the bicarbonate of potassium and sugar, and triturate them with a small quantity of the water so as to form a thin paste; continuing the trituration, slowly dilute with more water to the volume of about four fluid ounces, and strain through muslin; to the strained milky liquid add in small quantities at a time (with agitation) the sulphate of iron previously dissolved in an ounce of water, and make the mixture up to six ounces with water.

It is of a green colour, due to precipitated ferrous carbonate; by exposure to air or by keeping it becomes oxidised, changing to a brownish-red colour.

[1] Mistura Ferri Co. (*Charing Cross*).

Type V. The Admixture with Water of immiscible Fluids (fixed oils, essential oils, and oleo-resins, &c.). Pro vision for their mechanical suspension, by increasing the viscosity of the liquid in such a manner as to produce an emulsion.

(*a*).[1]

Lucy Stringer.

℞. *Ol. Ricini.* ℥ss.
Tr. Opii. ♏ xvj.
Pulv. Acaciae.
Pulv. Sacch. alb. *aa* ʒij.
Aq. *ad* ℥iv.
M. Ft. mist.
Coch. med j. *bis die ex aqua.*

July 5, 87. *G. H.*

Observations.—"The preparation of oily emulsions succeeds better, according to Overbeck, if the following proportions of gum be employed. Different oils conduct themselves differently when rubbed down with gum; castor-oil differing most in this respect from the other oils. In order to obtain a perfectly milk-white emulsion of castor-oil, 2 drachms of gum are to be mixed with 3 drachms of water and 1 ounce of castor-oil, which latter is to be poured by a fine stream into the constantly stirred mucilage. Any additional quantity of water is then readily taken up by the emulsion, which may also be prepared with only 4 scruples of gum, but without becoming quite white. For other oils half their weight of gum is required, and the quantity of water must be half the total weight of oil and gum. Thus, one ounce of oil of almonds is to be first rubbed down with half an ounce of gum, and six drachms of water are then to be added at once. The so-called crackling [*Kracken*] of the emulsion appears here in a higher degree than after the usual method, and is a favourable symptom of the uniform distribution of the oil on the water" (*Pharm. Journal*, 1st series, vol. xi. p. 31, 1851). In the author's opinion, nothing succeeds better for the emulsification of oils than an equal volume at least of the pharmacopœial mucilage of acacia; for castor-oil it seems specially adapted.

[1] Mistura Olei Ricini (*King's Coll.*).

The above mixture is an "artificial emulsion." Mucilage is incompatible with Liquor Ferri Perchloridi, with Borax, and with Lead Subacetate—forming insoluble compounds.

Mucilago Acaciæ should be recently prepared. By keeping, it becomes very acid, and unfit for use, much less for the production of emulsions.

"It is impossible to make a nice emulsion with some of the oils (the oil of male fern, for instance) unless the mucilage be quite fresh; if fresh mucilage is not at hand, half the quantity of the powder of acacia can be used; first rub the powder with the oil, then add water equal to double the weight of the powder, and rub till an emulsion is formed; now add by degrees any quantity of aqueous liquid ordered in the prescription" (*Squire*).

"Limpid" volatile oils (*e.g.*, *Ol. Terebinthinæ*) are more effectually emulsified with the yolk of an egg (*Ovi vitellus*); in the manipulation of such preparations, the yolk (already a natural emulsion proper) may be regarded as being so much mucilage of acacia; one yolk will emulsify about three fluid drachms of the essential oil to be operated upon. Stearoptens (*e.g.*, *camphora*) may be manipulated like the solid insoluble resins (with mucilage), although yolk of egg is said to be preferable for their suspension.

(*b*).[1]

Mr Townsend.

℞. *Copaibae Bals.* ʒiij.
Sp. Aetheris Nitr. ʒiij.
Muc. Acaciae. ʒvj.
Aq. Menth. Pip. ad ℥vj.
M. Ft. mist.
Cap. ℥j. *ter die inter cibos*

Mar. 10, 85. *W. K.*

Observations.—Extremely volatile liquids and nauseous medicines, like Copaiba and allied products, are also frequently administered in the form of elastic capsules of gelatine and of other materials, to be swallowed like pills.

Creasote is said to be most conveniently administered emulsified with mucilage of acacia; Liquid Extract of Liquorice masks its flavour well.

[1] Mistura Copaibæ (*Westminster*).

(*c*).[1]

B. Gibson.

R. Ext. Filicis Liq. ʒj.
Pulv. Tragac. Co. ʒss.
Aq. M. P. ad ℥iss.
M. Ft. haust.
Mane ante jentac. sumend.

Aug. 6, 89. D. E.

Lat. Recipe, Extracti Filicis Liquidi drachmam unam, Pulveris Tragacanthæ Compositi drachmam dimidiam, Aquæ Menthæ Piperitæ ad unciam unam cum semisse. Misce, fiat haustus. Mane ante jentaculum sumendus.

Type VI. The Admixture of Substances between which it is intended that the Dispenser shall effect Chemical Change (*lege artis*).

(*a*).[2]

Miss Andrews.

R. Ol. Amygd. Dulc. ℥ss.
Liq. Potassae. ♏ xxx.
Ol. Carui. ♏ j.
Aq. ad ℥vj.
M. Ft. mist.
A tablespoonful every two hours.

Observations.—Refer to remarks on "Saponification": such mixtures as the above, and the one following, are "pseudo-emulsions." Dilute the alkali with about a fluid ounce of water previous to saponification, which may be best effected by agitation in the phial. All acids, of course, destroy the emulsive character of these preparations.

[1] Mistura Filicis (*St Mary's*).
[2] Mistura Oleosa (*London*).

(*b*).[1]

M. Clandel.

R. Bals. Copaib. ʒiss.
Sp. Aeth. Nitros. ʒiij.
Liq. Potass. ʒiss.
Aq. Camph. ad ℥vj.
M. Ft. mist.
Cap. ℥j. *ter die.*

Observations.—Extend the above into unabbreviated Latin

(*c*).[2]

Ellen Gray.

R. Potass. Bicarb. ℈iv.
Acid. Citric. *gr.* lxxij.
Syr. Simpl. ℥iss.
Aq. ad ℥vj.
M. Ft. mist.
A wineglassful every two hours.

May 9, 84. *D. O.*

Observations.—Extend the above, and translate the directions into unabbreviated Latin. Dissolve the Potass. Bicarb. in the mortar with three ounces of water; then, to the mortar add the acid in small quantities at a time until effervescence has ceased; quickly complete the rest of the operation, since such mixtures are required in part for their agreeable gaseous acidity.

(*d*).[3]

Observations.—The following is evidently intended to contain a small amount of free chlorine in solution; when, after the admixture of the first two ingredients, the phial is found to be full of chlorine (readily observed by its greenish-yellow colour), the

[1] Mistura Copaibæ (*London*).
[2] Mistura Potassæ Citratis (*King's Coll.*).
[3] Haustus Chlori (*Fever Hosp.*).

operation may be completed in the usual manner, viz., by first adding the water in small quantity at a time with agitation, in such a manner as to best effect the solution of the gas, &c.

Mr Winter.

R. *Potass. Chlorat.* *gr.* iij.
Acid. Hydrochl. ♏ xviij.
Misce et adde.
Potass. Chlorat. ʒj.
Sp. Chloroform. ʒj.
Acid. Hydrochl. Dil. ʒiss.
Aquae. *ad* ℥vj.
M. *Ft. mist.*
℥j. *bis vel ter die ex aqua sumend.*

Jan. 4, 89. *J. P.*

Extend the above prescription into unabbreviated Latin. *Cf.* Types III. (*g*) ; IV. (*c*).

Sub-Group.

Of Medicines, between which it is intended that Chemical Change shall be effected (by the Nurse or Patient) immediately before administration.

(*a*).[1]

Mr Cox.

R. *Ferri et Amm. Cit.* ʒss.
Quinin. Sulph. *gr.* vj.
Acidi Citrici. ʒj.
Aq. *ad* ℥vj.
M. *Ft. mist. Cap.* ℥j. *ter die* c. *Pulv. Sodae Bicarb. gr.* x. *ex efferves.*

July 17, 89. *D. H.*

[1] Mistura Ferri et Quininæ Effervescens (*Consumption Hosp.*).

Lat.—Misce, fiat mistura, capiat unciam unam ter die cum granis decem Pulveris Sodii Bicarbonatis ex effervescentia.

Eng.—Two tablespoonfuls to be taken with one of the powders, during effervescence, three times a day.

Observations.—Six packages containing 10 grains each of sodium bicarbonate are implied, to be sent with the mixture.

In prescribing effervescing mixtures, care should be taken not to introduce any alkalis which are not carbonates (*e.g.*, the free ammonia in *Sp. Ammon. Aromat.*), which would frustrate the object intended.

(*b*).[1]

Rab. Potass. Bicarbonatis gr. 160.
Tr. Calumbae. ʒij.
Aquam. ad ℥viij.
M. Fiat mist.
Sig. The alkaline mixture.

Rab. Acidi Citrici. gr. 112.
Syr. Hemidesmi. ʒiv.
Aquam. ad ℥iv.
M. Fiat mist.
Sig. The acid mixture.

One tablespoonful of the acid mixture to be mixed with two tablespoonfuls of the alkaline mixture and taken while effervescing.

Mar. 6, 89. Mr Robson. L. L.

Observations.—Extend and translate the above into unabbreviated Latin.

[1] A form of effervescing mixture, consisting of two liquids in separate phials, the one containing an alkaline carbonate, the other an acid.

SATURATION TABLE.

20 grains		Grains of Citric Acid,	or	Tartaric Acid.
Ammonii Carbonas	neutralise	26·75		28·75
Sodii Carbonas	,,	9·8		10·5
,, Bicarbonas	,,	16·7		17·8
Potassii Carbonas	,,	17·0		18·0
,, Bicarbonas	,,	14·0		15·0
Magnesii Carbonas	,,	27·46		32·0

One fluid ounce of fresh lemon-juice contains between 36 and 46 grains of Citric acid.

Type VII. Substances between which the Dispenser shall endeavour to prevent Chemical Change (*lege artis*).

Incompatibles.

Medicines containing substances which chemically react in such a manner as to produce bodies which *à priori* were not anticipated, should necessarily never be prescribed, much less when the substances thus produced are of a potent or poisonous character. When a dispenser observes any palpable irregularities of this kind in a prescription, it is his duty above all not to reveal the matter to the patient or person presenting such prescription, but to respectfully confer with the prescriber on the subject, inasmuch as that it is in nowise warrantable for a dispenser to depart from the letter of a prescription without the sanction of the prescriber. Although in some prescribed medicines it may be possible by skilful manipulation (as by the order of mixing, &c.) on the part of the dispenser to prevent anticipated incompatibilities occurring, yet such prescribing is, in a measure, to be deplored, since it entails the possibility of injustice or even risk to the patient.

Sometimes "the dispenser of prescriptions is puzzled to know what *colour* to make the medicine, the colour being dependent upon the order in which the ingredients are mixed. For instance, a lotion was prescribed composed of calomel, lime-water, and chloride of zinc. If the calomel were decomposed first, the lotion was *black;* if the chloride of zinc first, it was *white.*"

Again, a lotion made according to the following prescription is either transparent and colourless, or opaque and of a brick-red, according to the order in which the ingredients are mixed (*Hanbury*):—

℞ Potass. Chloratis.
Boracis, ... aa ʒss.
Hydrarg. Perchlor., . . gr. iv.
Glycerin., ... ℥ss.
Aquæ, ... ad ℥viij.
Misce.

FA

Fatal consequences are said to have resulted from the development of free iodine or bromine (causing a red coloration)[1] in mixtures such as the following:—

No. 1.		No. 2.	
Potass. Iodid., .	ʒiss.	Potass. Chlorat., .	ʒiss.
Sp. Ætheris Nitrosi,	ʒvj.	Syr. Ferr. Iodid., .	℥j
Aq., . .	ad ℥vj.	Aq., . .	ad ℥vj.

In No. 1 the liberation of free iodine (bromine if a bromide were used) is due to the presence of free acid in the Spirit of Nitrous Ether:

$$C_2H_5NO_2 + KI + HNO_3 = KNO_3 + C_2H_5HO + NO + I.$$

Sp. Ætheris Nitrosi, as well known, frequently contains (unavoidably) a little free nitric acid; such, when prescribed as above, requires previous neutralisation with a little Potass. Bicarb.[2] when dispensed.

In No. 2 the following decomposition probably takes place:

$$2FeI_2 + KClO_3 = Fe_2O_3 + KCl + 2I_2.$$

No. 3.

Liq. Strych. Hyd., . .	ʒiij.
Sodæ Bicarb., . . .	ʒiss.
Aquæ, . . .	ad ℥iv.

In No. 3 the free alkaloid crystallises out. Indeed, most alkaloids are liberated from their salts, and generally precipitated, by free alkalis, alkaline carbonates, &c., *e.g.*,

No. 4.

℞ Potassii Iodidi, . . .	℈j.
„ Bicarb., . . .	ʒiss.
Ferri et Quin. Cit., . .	℈iv.
Tinct. Valerian. Amm., .	ʒj.
Aquæ, . . .	ad ℥iv.

Misce. Sumat cochleare medium ex aquâ ter die.

In the above the quinine is precipitated in a tenacious mass.

[1] Mixtures containing sodium salicylate in the presence of either *Sp. Ætheris Nitrosi* or *Sp. Ammoniæ Aromaticus* likewise develop a red coloration.

[2] To save this trouble, it is sometimes customary to keep some crystals of Pot. Bicarb. at the bottom of the *Sp. Æth. Nit.* stock-dispensing bottle, thus ensuring its neutrality.

For a similar reason poisonous alkaloidal tinctures (*e.g.*, Tr. Nucis Vom.) should not be prescribed with alkalis, neither with iodides or bromides, with both which latter, insoluble alkaloidal compounds are apt to be formed. Alkalis decompose chloral hydrate with liberation of chloroform.

Acid. Hydrocyanicum Dil. (also Aq. Laurocerasi) forms with solutions of morphine insoluble morphine cyanide; it is likewise incompatible with calomel, forming mercuric cyanide and hydrochloric acid, with liberation of mercury. Methylated spirit (unless freed from acetone) when mixed with iodine, develops acrid irritating vapours, said to consist of acrolein and iodised acetone.

Combinations attended with Ignition of the Ingredients (*Pills and Powders*).—Substances rich in oxygen, and which readily part with it under suitable conditions, should not be mixed with readily oxidisable substances, or so-called "explosive" compounds may be formed. Among the former are chlorates, iodates, permanganates, nitrates, picrates, and bichromates: among the latter are charcoal, sulphur, iodine, carbolic acid, glycerine, turpentine, and organic compounds generally.

Experiment.—(1) Knead together in a pill mortar 10 grains of Potassium Permanganate with a little confection of roses. (2) Rub ½ oz. of Chlorinated Lime into a paste with glycerine, and observe what happens.

The above are among the more important of the incompatibilities likely to occur; to enumerate all which have from time to time been reported upon in medical and pharmaceutical literature is not the object of this work.

A Gargle.[1]

Mr Staples

℞.	*Aluminis.*	*gr.*	xxx.
	Acid. Sulph. Dil.		ʒj.
	Tinct. Myrrh.		ʒij.
	Aq.	*ad*	℥vj.
M.	*Ft. Gargar.*		
	Saepe utend.		

Jan. 10, 89. *K. J.*

[1] Gargarisma Commune (*London*).

Observation.—Ordinary mouth-washes are termed *Collutoires* (Fr.).

Collyrium.

"A Collyrium is a liquid application to the eyes, some of which are simply astringent, consisting of the solutions of salts of lead or lime, or of vegetable infusions, while others combine with the astringent the virtues of a stimulant. They are necessarily extemporaneous compounds" (Paris' *Pharmacologia*).

(*a*).[1]

Amy Winchester.

R. Zinci Sulphat. gr. viij.
Aq. ad ℥iv.
M. Ft. Collyr.
m.d. utend.

Feb. 3, 69. *A. B.*

Observation.—The directions to the patient are "more dicto utendum." To be used as directed.

Guttæ.

(*b*).[2]

John Ashton, Esq.

R. Atropin. Sulph. gr. iv.
Aq. ℥ij.
M. Sign.
The drops for the eyes.

FIG. 73.—A serviceable little instrument for the use of the patient.

Observation.—The Guttæ of the Dental Pharmacopœia are applications intended for carious teeth.

[1] Collyrium Zinci Sulphatis (*St George's and Westminster*).
[2] Guttæ Atropiæ Sulphatis (*London Ophth.*).

Vapores.[1]

Vapor Pini Sylvestris (*Throat Hos.*).

Miss Agnes Howitt.

R. Ol. Pini Sylvest. ʒij.
Magnes. Carb. Lev. ʒj.
Aq. *ad* ℥iij.
M. Sign. *The Inhalation.*

A teaspoonful to be mixed with a pint of hot water (140° F.) for each inhalation.

Observations.—The oil to be first well triturated in a mortar with the magnesia, thus as it were increasing the surface of the oil, and facilitating its subsequent contact and solution with the water. The above preparation must not be filtered. This method of impregnating water with oil is sometimes resorted to in the production of the medicated distilled (!) waters; such practice is, however, unjustifiable, inasmuch as magnesia is slightly soluble in water; while kaolin or cotton (cotton-wool) is preferable to magnesia for such purposes, the products materially differ from those obtained by distillation, their substitution for the latter being improper.

Injectiones.

[*Example.*—Injectio Zinci Sulphatis (*King's Coll.*).]

Mr Drummond.

R. Zinci Sulphatis.
Aluminis *aa gr.* viij.
Aq. *ad* ℥iv.
M. Ft. inject.

To be used as directed.

Mar. 20, 70. *E. G.*

[1] Certain very volatile liquids (*e.g.*, ethyl iodide, and amyl nitrite), when intended for inhalation, are obtainable sealed in thin glass capsules (holding 5 or 10 minims) encased in cotton-wool and silk When required for use the capsule is snapped by squeezing the package, and inhaled.

Injectiones Hypodermicæ.

Hypodermic and other Alkaloidal Solutions.—"It is well known that solutions of most alkaloids, especially if dilute, quickly undergo change, becoming turbid, and developing a fungoid growth. This proneness to deterioration on keeping has brought about the introduction of hypodermic discs and tabloids, with the view of furnishing the physician with definite quantities of the alkaloids in a convenient form, so that by dissolving them at the time of administration, the patient may be secure from the evil effects arising from the use of a decomposed solution. In the extreme cases in which hypodermic injection is frequently resorted to, delay, however slight, may be most dangerous ; and as a hypodermic disc or tabloid has to be dissolved before it can be used, the advantage of a ready-made solution, if it could be kept free from change, is evident.

"The sores which sometimes result from the puncture of the needle of the injection syringe are said to be caused by the presence of micro-organisms in the injections employed, and inflammation of the mucous membrane has been produced by solutions of cocaine hydrochlorate containing fungoid growths. Solution of acetate of morphia, by long keeping, becomes of a deep brown colour, and it is remarkable that the sickness which was erroneously supposed to be due to the formation of apomorphia was always observed when old solutions were injected. May not this deep colour indicate the formation of some decomposition product of the alkaloid possessing properties different from those of morphine acetate ? Solution of apomorphia develops a deep green colour on keeping, and cases have been reported in which alarming results have followed the injection of an old solution of apomorphia. It is, however, generally understood, on medical authority, that this discoloration does not sensibly interfere with the therapeutic effect of the alkaloid.

"The germs of micro-organisms are introduced into liquids primarily from the atmosphere, and finding in an alkaloidal solution a suitable nutrient medium, develop and multiply at the expense of the alkaloid, and give rise to the turbidity and fungoid growths already alluded to. Three methods have been proposed to obviate this defect :—

"1. The preparation of small quantities of solution at a time.

"2. The use of antiseptics to destroy the germs or prevent their development.

"3. The preparation of the solution with sterilised materials and its preservation in sterilised vessels.

Against method No. 1 may be urged the delay involved, and the inconvenience of so frequently preparing the solutions.

Method No. 2. The following substances have been proposed from time to time as efficient preservatives for alkaloidal solutions:—

	In the proportion of
Carbolic acid,	·16 p.c., 1 p.c., 3·3 p.c.
Glycerine,	20 p.c.
Carbolic acid and glycerine,	6·6 p.c. to 15 p.c.
Sulphurous acid,	·6 p.c. to 1 p.c.
Chloroform,	as chloroform water.
Camphor,	·4 p.c.
Benzoic acid,	1 to 2 grs. to the fl. oz.
Boracic acid,	·5 p.c., 1 p.c., 1·1 p.c.
Salicylic acid,	½ gr. to the fl. oz.
Thymol,	·1 p.c.
Mercuric chloride,	·005 p.c. for sol. cocaine.

"Salicylic and benzoic acids have been used as preservatives, but boracic acid, from its well known and non-irritating and sedative action, is superior to any other antiseptic for this special purpose. Make a saturated solution in the purest distilled water attainable, boil for fifteen minutes, cool, and filter carefully. Solutions of cocaine prepared with this keep well for any reasonable length of time, and there appears to be less objection to boracic acid than to any other of the substances which have been suggested" (*Pharm. Jour.*, 1889, F. C. J. Bird).

The use of hypodermic injections is not, as a rule, entrusted to the patient.

Electuaria.

The "Electuary" is an ancient form of prescription; for although the term "*Electuarium*" is first used by Cælius Aurelianus, yet the ἐκλικτον of Hippocrates, and the *Antidotus, Confectio, Mithridatium, Dioscoridum, Opiatum, Orvictanum, Philonium, Theriaca,* and *Requies* of other authors, were all electuaries; and though modern science has dismissed a number of these galenical preparations as cumbrous, still it is occasionally useful in modern practice, as it enables the physician to administer a large quantity of a powder or extract in the least unpleasant form.

Electuaries differ from *Conserves* in the less proportion of their sugar, and in the object for which it is introduced; in the latter it is merely intended to *preserve* the ingredients, whereas in the former its purpose is to impart convenience of form. The London College now comprehends under the title of *Confections* the conserves and electuaries of its former pharmacopœias. The name of electuary, however, is still retained in extemporaneous prescriptions. It is usually composed of dry powder, formed into a proper consistence by the addition of syrup, honey, mucilage, or conserve of roses; when mucilage is employed the electuary very soon becomes dry and hard; and when common syrup is used, the mass is apt to candy, and in a day or two to grow too hard for use; this is owing to the crystallisation of the sugar.

I. Those substances which are nauseous, deliquescent, or which are incapable of forming an intimate union with syrup, as fixed oils, balsams, &c., should never be prescribed in this form.

II. The proportion of the excipient must be regulated by the nature and specific gravities of the substances which enter into its composition, *e.g.*:—

1. Dry vegetable powders require twice their weight of syrup or honey.

2. Gummy and resinous powders, an equal weight.

3. Hard mineral substances should be formed into an electuary with some conserve, since they are too ponderous to remain suspended in syrup. Saccharine matter, however, is always to be preferred to mucilage on account of its conservative virtue, as already fully explained.

In apportioning the dose of an electuary, unless a single one be directed, it is usual to refer to a standard of bulk rather than to one of weight, viz., *ad nucis avellanæ, juglandis, castaneæ, magnitudinem; vel instar nucis moschatæ; aut quantum cochleari mediocri capi vel cultri apice attoli, possit* (Paris' *Pharmacologia*).

Confectio Aperiens (*Charing Cross*).

Mary Cross.

R. Pulv. Sennae.
Sulph. Sub. *aa* ℥ss.
Potass. Tart. Acid. ℥i.
Mell. q.s.
M. Ft. confectio.
A teaspoonful when reqd.

Jan. 3, 7d. *W. G.*

Pulveres.

The form of powder is in many cases the most efficient and eligible mode in which a medicinal substance can be exhibited, more especially under the following circumstances:—

(1) Whenever a remedy requires the combination of all or most of its ingredients to ensure its full effects, and its bulk precludes its convenient exhibition in the form of pills, as Bark, Ipecacuanha, Jalap.

(2) When medicinal bodies are insoluble, and consequently indisposed to undergo those essential changes, *in transitu*, which render them operative, minute division will place their particles in more immediate contact with the solvent or decomposing powers of the stomach.

(3) Gummy bodies that are liable to agglutinate, or those which deliquesce on exposure to the air, do not admit of this form of exhibition (Paris' *Pharmacologia*).

(*a*).[1]

Mr Smith.

R. Bism. Subnit. *gr.* v.
Pulv. Rhei Co. *gr.* viij.
Sod. Carb. Exsicc. *gr.* v.
Pulv. Doveri. *gr.* ij.
M. Ft. pulv.
Ex aq. s.o.s.sd.
Mitte vj.

Mar. 2d, 73. *J. L.*

[1] Pulvis Bismuthi c. Rheo (*Charing Cross*).

Observations.—Fiat pulvis, ex aqua si opus sit sumendus. (Mitte sex.) Let a powder be made.—"One to be taken in water as required." (Send six powders.) In mixing powders, reduce any lumpy or crystalline ingredient (or ingredients) to an impalpable powder by light trituration in a dry mortar, add the other ingredients (known to be impalpable powders), and mix by light trituration.

FIG. 74.—A mortar for trituration purposes.

Cachets.—Nauseous powders are sometimes enclosed between two circular pieces of wafer-paper (termed "cachets")—the whole to be dipped in water immediately before swallowing. Empty gelatine capsules for similar purposes are also readily obtainable.

(*b*).[1]

Charles Gross.

R. Santonin. ℈j.
Hydrarg. c. Cret. *gr.* viij.
Scammon. ℈j.
Misce. et div. in Pulv. iv.
Cap. j. *om. alt. noct. h.s.*

Apr. 5, 68. *W. O.*

Lat.—Misce et divide in pulveres sex, capiat unum omni alterna nocte hora somni.

Eng.—Mix and divide into four powders, "One to be taken every other night at bed-time."

Pilulæ.

"Medicines prepared in a pilular form are very portable, as they can be supplied to the patient in the smallest possible bulk in equally apportioned doses. The pill is a convenient mode of administering nauseous medicines—those that are insoluble in water and not easily suspended in it, and those drugs whose gradual action is required. A pill should be perfectly globular and firm, so as not to lose its shape, yet should not be too hard so as to be insoluble, or even slow in dissolving, unless the prescriber wishes it, as is sometimes the case; *e.g.*, 5 grains of dried sulphate of iron with one minim of syrup form a not very large but useful pill, which, by dissolving slowly, does not derange the stomach, whereas an equivalent dose of the salt in solution

[1] Pulvis Vermifugus (*Charing Cross*).

would, in many cases, act as an emetic. Again, dinner pills of aloes and mastic are prescribed to be made up with spirit by some physicians, who intend them to dissolve, not in the stomach, but in the bowels principally, where their peristaltic action is required. It is the duty of the dispenser not to deviate from using the excipient ordered, unless, for example, a fluid excipient is ordered along with extracts whose normal condition is too soft to begin with. If the choice of the excipient be left to the dispenser, as is often the case, he should choose one which will not be incompatible with, but if possible, have a preservative action on the other ingredients of the pill, neither inconveniently increase its size nor interfere with the quick or prolonged action intended by the prescriber.

"The pill mass, in the first place, should be firm and solid, yet possess tenacity and be plastic when worked. As in building a wall, bricks and mortar are required in due proportion, so a good pill mass requires particles void of fluidity, with adhesive, semi-fluid substance to bind them together. Where there are but little fibrous or insoluble solid particles prescribed, the mass should be made as hard as possible and quickly rolled out, else the pills will not keep their shape. Most vegetable powders contain fibrous matter, and have their adhesive properties while dry in a latent condition, these merely require a suitable fluid added to develop their tenacity, and enable them to be rolled into pills. As a powerful solvent and preservative, glycerine, diluted with one-half its volume of rectified spirit, used discreetly, is a good excipient for such powders. If used in the pure state in the slightest excess, glycerine, being slightly hygroscopic, causes the pills in time to have an unsightly moist appearance; whereas, if diluted with spirit, the spirit readily evaporates from them. Glycerine in any form should not be used as an excipient for hygroscopic drugs, such as soft extracts, squills, aloes, &c. For these mucilage of acacia or syrup is preferred. For insoluble metallic salts,glycerine requires additional adhesiveness, for such and a number of other drugs,it is best used in the form of glycerine of tragacanth, adding, if necessary, a small quantity of powdered acacia or althæa to give firmness to the pill. The use of glycerine should be avoided in pills intended to be varnished; in place of glycerine of tragacanth, use for these a little of equal parts of acacia and tragacanth, with syrup *q. s.* Powders to be formed into pills should be as finely comminuted as possible; any poisonous alkaloid or very active drug should be well triturated with some less active powder, or, if the formula contains no other powder, with a little sugar of milk, before mixing with the other ingredients. Having mixed the powders, and diffused any essential oil evenly through them, the extracts and other excipients should be added, the whole well pounded into a mass, rolled into pills, and dusted over with lycopodium, powdered starch, or French chalk, in the usual manner.

"But the public now requires pills to be made as tasteless and as small as possible. A 1-grain pill is much preferred to a 5-grain one; yet, unless specially ordered otherwise, when the ingredients prescribed for each pill weigh less than 1 grain, it is a rule with dispensers, for uniformity's sake, to triturate the ingredients with sugar of milk and glycerine of tragacanth *q. s.* to make each pill weigh 1 grain. These excipients, glycerine of tragacanth and sugar of milk, generally are as neutral as any that can be chosen. Pills made with them will remain plastic and active any length of time.

"As a means of rendering pills tasteless, silvering or gilding are giving place to covering them with solution of sandarach (varnishing), gelatine, or pearl-coating them with French chalk and gum, or sugar-coating them" (Martindale, *Extra Pharmacopœia*).

Varnishing.—(Sandarach and absolute alcohol, equal parts.) The pills must be firm and free from powder; after agitation with a few drops of the

solution they are to be placed on a slab to dry, turning them occasionally. The process may require repeating; they should not be boxed until after being exposed to the air for an hour or two.

Gelatine Coating.—"Roll the pill from a good stiff mass; coat thinly with a solution consisting of 1 ounce of resin of tolu in 5 fluid ounces of ether, without the use of powder of any kind; after fifteen or twenty minutes the pills may, by the use of the Porcupine or any similar machine, be coated with the following solution: opaque gelatine (such as Nelson's or Star), 1 part; mucilage of acacia, 1 part; water, 5 parts; the gelatine to be soaked in the water for half an hour, dissolved in a water-bath, and the mucilage added. There is no object in the addition of sugar, and nothing is gained by its use. Boric acid is added to preserve the prepared gelatine in bulk, but I prefer to omit it, and use the fresh solution when any quantity of pills for stock are to be coated. If it is desired to set it aside and use from day to day, the addition of a few drops of chloroform after each occasion answers the purpose quite well, and is driven off on rewarming. It must, however, be borne in mind that gelatine solution is weakened each time it is heated, the small quantity of phosphate of calcium which it holds in solution becoming precipitated, and so impoverishing its solidifying power and tenacity" (Symes, *Pharm. Journal*, 1888).

"*Keratin Coating.*—Keratin has been employed and recommended by Unna and Beiersdorf for the making of keratinised pills, or 'pills for the small intestine.' Pills coated with a layer of keratin, which is insoluble in the gastric juice, are not dissolved until they reach the intestines, when they come under the action of the alkaline bile, which dissolves the keratin.

"The medicines which may advantageously be administered under this form are rather numerous. Among them may be mentioned—

"(1) Medicines that can by prolonged contact cause irritation to the mucous membrane of the stomach: arsenic, salicylic acid, creasote, chrysarobin, quinine compounds, copaiba balsam, cubebs, ferruginous preparations, and especially perchloride of iron, opium, mercurial preparations, biniodide and bichloride of mercury, phosphorus, and all the tænifuge preparations.

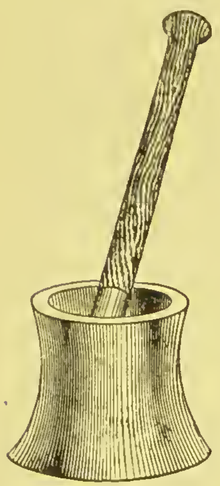


FIG. 75.—A pill mortar.

"(2) Medicines that can injure the digestion by giving insoluble precipitates with pepsin and peptones: tannin, alum, acetate of lead, preparations of bismuth, nitrate of silver, corrosive sublimate, &c.

"(3) Medicines that are rendered inactive or decomposed by the gastric juices: alkali, bile, soap, sulphide of calcium, sulphide of iron, pancreatin, &c.

"(4) Medicines which should arrive in the intestines as concentrated as possible: kousso, santonin, extract of male fern, alkali.

"Keratin is prepared by Unna by steeping parings of horn in a digestive liquid composed of pepsin, 1 gram; hydrochloric acid, 1 gram; and water, 11 grams, as long as the shavings yield anything to the solvent. The residue is then dissolved in ammonia by maceration lasting several weeks, after which the solution is evaporated to the consistence of syrup.

"To coat the pills they should be dipped in cacao butter, rolled in charcoal powder, and then keratinised. For this purpose the pills, placed in a porcelain capsule, are sprinkled with a suitable quantity of keratin solution and then shaken together until the evaporation of the solvent. This moistening and drying requires to be repeated several times (as many as ten) before the layer of keratin is sufficiently thick. The process employed for

coating pills with gelatine, which consists in dipping into the solution the pill fixed on the point of a needle, is not suitable here, for it leaves a hole through the keratin coating that can never be completely closed.

"In order to ensure that the keratin used is insoluble in the stomach, Unna recommends that a preliminary experiment should be made with sulphide of calcium pills coated with it. If, in the course of some hours after such pills are taken, eructations of sulphuretted hydrogen are observed, it would indicate that the pills have been dissolved in the stomach. When the keratin is of good quality nothing of the kind should occur. Finally, to complete the test, the pills, when placed in water, should not liquefy or crack" (*Pharm. Journ.*, 1888-89).

(*a*).[1]

Mr Barber.

R. Aloes Barb.
Scammon.
Pulv. Jalap.
Pulv. Zingib. aa gr. j.
Theriac. q.s.
Ft. pil.
Cap. ij. *hor somni p.r.n. Mitte* xij.
Sep. 7, 89. *J. R.*

Lat.—Fiat pilula. Capiat duas hora somni pro re nata. Mitte duodecim.

Eng.—Let a pill be made. Send 12 such pills. Two to be taken at bed-time when required.

(*b*).[2]

Mrs Donkin.

R. Pulv. Rhei gr. xxiv.
Pulv. Aloes Soc. gr. xij.
Pulv. Saponis gr. viij.
Pulv. Ipecac. gr. iij.
Tinct. Rhei q. s.
Ft. pil. xij.
Cap. ij. *om. alt. noct. In arg.*
July 10, 89. *K. P.*

[1] Pilula Aperiens. (*London Ophth.*). [2] Pil. Rhei Co. c. Ipecac. (*Westminster*).

Linimenta.

"These are compositions which differ principally from ointments in having the consistence of oil, which imparts to them a form highly convenient for friction upon the skin" (Paris, *Pharmacologia*)—Linimenta Aconiti, Belladonnæ, and Iodi are used as paints (*pigmenta*).

(*a*).[1]

Wm. Isaacs.

R. Liq. Ammoniae.
Ol. Olivae aa ℥ij.
M. Ft. Lin.
Ad part. affect. affricand.

July 1, 87. *W. G.*

Ad partem affectam affricandum. To be rubbed on the part affected.

Recommendation by the Pharmaceutical Society of Great Britain for the Dispensing of Poisons.—That in the dispensing and selling of poisons, all liniments, embrocations, and lotions containing poison be sent in bottles rendered distinguishable by touch from ordinary medicine bottles, and that there also be affixed to each such bottle (in addition to the name of the article, and to any particular instructions for its use) a label giving notice that the contents of the bottle are not to be taken internally.

(*b*).[2]

Mrs Staples.

R. Liq. Ammon. Acet. Fort. ʒiij.
Sp. Vini Tenuior. ʒx.
Aq. *ad* ℥iv.
M. Ft. embrocatio.

June 4, 85. *O. M.*

Lotiones.

"Remedies of a liquid, but not of an oily nature, to be applied more or less generally to different parts of the body.

"When the whole surface of the body is the subject of their application they fall under the denomination of *Balneum humidum*" (Paris, *Pharmacologia*).

[1] Linimentum Ammoniæ (*London Ophth.*).
[2] Embrocatio Communis (modification of, *Guy's*).

(*a*).[1]

Thos. Chambers.

R. *Hydrarg. Subchlor. gr* xl.
Muc. Acaciae ʒj.
Liq. Calcis *ad* ℥iv.
M. *Ft. Lotio.*
For external use, as directed.

Observation.—Mucilage of Acacia being always more or less acid, it should be added last of all.

(*b*).[2]

Mrs Harper.

R. *Liq. Plumbi Subacet.* ♏ xxvij.
Tr. Opii (Meth.) ♏ lxxij.
Sp. Tennior. ♏ xxxvj.
Aq. ℥vj.
M. *Ft. Lotio.*
Nocte maneque more dict. appd

Observations.—Dilute each of the first two ingredients well with water before mixing them. Solution of Lead subacetate precipitates all kinds of astringent vegetable matter.

(*c*).[3]

Mrs Fox.

R. *Aluminis* *gr.* xxvij.
Decoct. Querc. ad ℥vj.
M. *Ft. Lotio.*
To be applied with lint.

Oct. 10, 75. *W. E. G.*

[1] Lotio Nigra (*St Mary's*).
[2] Lotio Plumbi c. Opio (*St Mary's*).
[3] Lotio Aluminis c. Decoct. Quercus (*St Thomas's*).

Pigmenta, or Paints.

Pigmentum Iodi (*London*).

Mr Fitch.

R. Iodi. ℈ij.
Pot. Iodid. ℈j.
S. V. R. ad ℥iss.
M. Ft. pigment.
To be applied with a camel-hair brush.

Observations.—A notable incompatible with iodine is aqueous or alcoholic solution of ammonia; such solutions are apt to deposit a black powder (nitrogen iodide), which latter, upon becoming dry, is very dangerously explosive. $4NH_3 + 3I_2 = NI_3 + 3NH_4I$.

Unguenta.

"These are fats and oils, with which various active substances are incorporated, either by simply mixing the ingredients by trituration, or liquefying them by the aid of a gentle heat" (Paris, *Pharmacologia*).

Plaster and Salve Mulls are mechanical contrivances, by which medicaments may be accurately applied locally, the medicinal substance being supported *in situ* by a firm unctuous basis—generally spread on muslin.

(*a*).[1]

Mr Hastings.

R. Hydrarg. Oxid. Rub. (Levigt.)
Hydrarg. Ammoniat. aa gr. vj.
Adipis. ℥j.
M. Ft. unguent.
Jan. 2d, 84. *A. B.*

Observations.—Use slab and vulcanite spatula for ointments. Crystalline or lumpy solids should be previously reduced to an impalpable powder in a mortar and transferred to a slab, there to be mixed with remaining semisolid ingredients, with a pliable vulcanite spatula. Aqueous and spiritous plastic extracts may be

[1] Unguentum Mercuriale Co. (*Skin Hosp.*).

previously attenuated by rubbing down (on a slab) to a creamy consistence with aid of a little water or proof spirit respectively, previous to admixture with the basis.

(b).[1]

Mrs Cullen.

R.	Ext. Bellad.	gr. x.
	Hydrarg. Ammoniat.	gr. v.
	Adipis.	ʒj.
M.	Ft. ung.	

Observation.—If extract be too stiff, first reduce it to thick creamy condition with a few drops of water (on slab).

Collunaria—(Nasal Douches).

Hal.	Sodae Biboratis.	ʒiv.
	Sodii Chloridi.	ʒiv.
	Aquae	ad ℥viij.
M.	Fiat sol.	

Sig. Two tablespoonfuls to be used diluted with half a pint of warm water as douche for the nose as directed.

Apr. 7, 89. Mr Goldstone. L. L.

Suppositoria.

"This is an ancient form of preparation; it affords a very efficacious mode of administering many powerful medicines, and, in some instances, of producing effects which the same remedy, if given in any other form, would not be able to command; besides which, it is found that after the stomach, by long use, has lost its susceptibility, the same substance will operate with fresh and unabated force if applied to the rectum. There are two great indications which *suppositories* are calculated to fulfil:—

[1] Unguentum Belladonnæ (*King's Coll.*).

"1. The alleviation of pain and irritation.

"2. The production of catharsis" (Paris, *Pharmacologia*).

"The suppositoria of the British Pharmacopœia are divided into two classes: those with oil of theobroma as a base, and those with curd soap. The former are melted and poured into a mould; the latter are best made by hand. The glycerinum amyli ordered in the suppositoria cum sapone may be readily prepared from either wheat or rice starch.

"When these soap compounds are extemporaneously dispensed, and are intended for immediate use, the starch glycerine appears to be in excess, and,

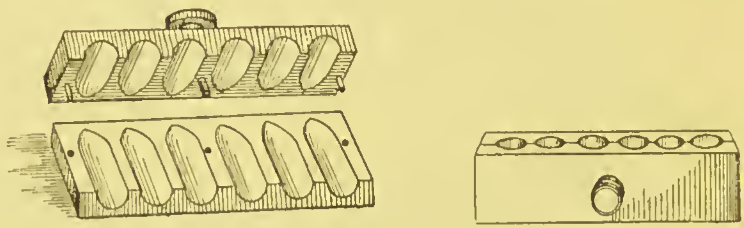


FIG. 76.—A 15-grain suppository mould, opened and closed.

taking the quantities specified in the official formula, one scruple must be substituted for half a drachm. The excess is apparent only, for, on keeping, the suppositories stiffen into a mass, the consistence of which leaves nothing to be desired. The quantity of 'starch in powder' is left to the discretion of the pharmacist, but that prepared from rice is strongly to be recommended. Its firm granular texture renders its use specially advantageous in obtaining the required suitable consistence" (Ince, *Pharm. Journ.*, 1889).

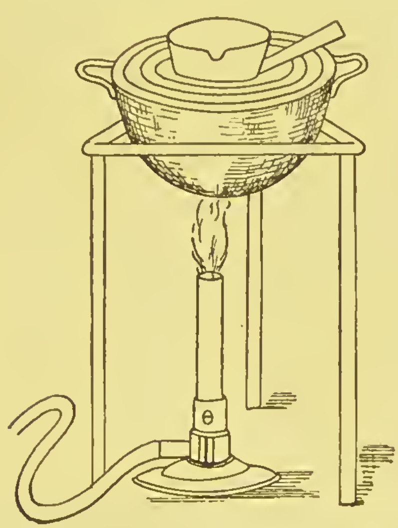


FIG. 77.—Small water-bath and porcelain dish for preparation of suppositories.

"To ensure success in the making of suppositories and also bougies, the two chief points which require attention are the temperature of the mass at the time of moulding and the thorough chilling of the mould. With respect to the former condition, it is important that the cocoa butter be not allowed at any stage to pass beyond a creamy consistence, in order to prevent the subsidence of solid medicaments and the coherence of those of a resinoid nature.

"Various substances have been proposed as lubricants for suppository moulds, such as linimentum saponis, soft soap, and glycerine, &c.; but for general purposes the first named is most satisfactory. When used for some suppositories it frequently produces an unsightly efflorescent appearance on their surfaces, and this is especially noticeable on those containing dark-coloured extracts, as belladonna, hamamelis, &c.

"In such cases a solution containing—

Castor-oil,	1 part	Dissolved and filtered.
Hard soap,	2 parts	
Rectified spirit,	18 ,,	
Water,	2 ,,	

gives the best results.

When green extracts are prescribed in suppositories it is generally recommended that the extract be reduced with water to a creamy consistence. I have often noticed that suppositories made in this manner become covered with mould if kept for any length of time. A solution of—

S.V.R.,	7½ parts.
Water,	2½ ,,
Sapo mollis,	1 part.

used for softening the extract will prevent this, and, as a further advantage, the extract will be found to mix much more uniformly with the cocoa butter.

"*Glycerine Suppositories.*—Since the introduction of glycerine as a remedy for constipation, various formulæ have been proposed with the view of superseding the method of injection with its attendant inconveniences by exhibiting the glycerine in the solid state in the form of a suppository. These are dependent on the use of either soap or gelatine for solidifying the glycerine. The following is a formula recommended for those containing soap :—

Dialysed stearic soap, dried and powdered,	1 part.
Water,	1 ,,

Rub together and add—

Glycerine,	9 parts.

Heat till dissolved, then evaporate until all the water is dissipated.

Stearic acid soap is the only kind which will answer, curd soap not forming a sufficiently hard mass. According to the above, the suppositories contain 10 per cent. of soap, a proportion which gives them too high a melting-point. I find that 5 per cent. of soap is quite sufficient to solidify the glycerine, and have, therefore, adopted the following formula, which gives a suppository melting at about 98° F. :—

Powdered stearic soap,	5 parts.
Glycerine,	95 ,,

Mix thoroughly, and heat till dissolved.

"If exposed to the air these suppositories deliquesce. This is best prevented by dipping them as soon as made into collodium flexile, and thus treated they are quite permanent. Stearic acid soap may be made by the process given by Dieterich :—

Stearic acid, pure, ... 4 oz. 250 grs.

Melt, and add gradually with constant stirring to

Crystallised carbonate of soda, ... 2 oz. 245 grs.

dissolved in

Water, ... 13¾ fl. oz.

heated in a water-bath. When effervescence ceases, add

Alcohol, ... 3 fl. dr. 20 m.

Cover the vessel, and set aside for six hours. Add sufficient boiling water to just dissolve the soap, pour into a dialyser and float in distilled water kept hot. Change the water occasionally until no further impurities are extracted.

Evaporate the purified soap to dryness on a steam-bath.

It may also be prepared by 'salting out:'—

Take of Salt,		1 oz. 63 grs.
,,	Crystallised carbonate of soda,	50 grs.
,,	Water,	3 fl. oz. 3 fl. drs.

Filter and add to the soap solution. Heat until completely separated, collect on fine muslin; drain and press. By this process the soap contains chlorides.

Glycerine suppositories prepared with gelatine:—

Gelatine, ... 1 oz.

Soak in water for a few minutes, drain, allow to swell, and add

Water, ... 1 oz.

Dissolve in a water-bath, and add

Glycerine, ... 9 ozs. by weight.

Heat until the water is driven off.

If a 30-grain mould be used, the 'gelatine' suppositories contain 27 minims of glycerine, and those prepared with soap rather more than 30 minims. Contrasting the two formulæ, I prefer the one with the soap basis, as the soap suppositories appeared to be the more easily liquefied, and the glycerine in them is in a state of greater concentration" (F. C. J. Bird, *Pharm. Jour.*, 1889).

(*a*)[1]

James Brocklank.

℞. Morphin. Hydrochl. gr. iij.
Ol. Theobrom. ʒiss.
M. Ft. suppos. vj.

i. omni nocte utend.

(*b*).[2]

Mrs Newnham.

℞. Ac. Tannici gr. xviij.
Glyc. Amyli gr. xv.
P. Sapon. Animal. gr. 50.
Amyli q.s.
Ft. suppos. vj.

Pessi (*pessus*, nom. sing.) or Pessaries are medicaments intended for introduction into the vagina; as with suppositories, either theobroma or a mixture of glycerine and gelatine is adopted for their basis. Weight of each—about 120 grains.

[1] Suppositoria Morphinæ (*Ph. B.*).
[2] Suppositoria Acidi Tannici cum Sapone (*Ph. B.*).

Buginaria (*buginarium*) or Bougies are of two kinds, nasal and urethral; bases similar to the foregoing are used in their preparation. They are necessarily cast in pencil-like forms, varying in length from 2 to 6 inches.

Pastilli (*pastillus*) or Pastils are medicated lozenges prepared with a glycerine and a gelatine basis. [Pastilles are dried conical masses of aromatic medicinal substances incorporated with nitre or potassium chlorate, used for their products of combustion (slow deflagration).]

Pastæ (*pasta*) or Pastes are generally caustic substances with a plastic amylaceous basis, intended for external application, on lint.

Emplastra.

These are solid preparations adhesive at the ordinary heat of the body. When prescribed, the requisite quantity (generally left to the dispenser to adjudge) is intended to be spread upon leather or other material as designated.

Mr Banks.

Habt. Emp. Bellad. 4 × 5.
Sup. alut. extend.
To be applied as directed.

Observations.—Super alutam extende. Spread on leather. Set

FIG. 78.—A plaster-iron.

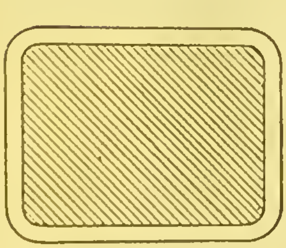


FIG. 79.—A form for a plaster.

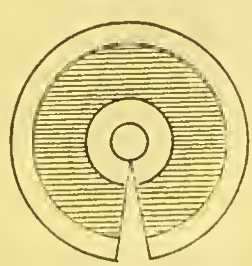


FIG. 80.—A form for a plaster for the breast.

the plaster-iron to warm over a Bunsen flame. Cut out a mould of

desired shape in brown paper, immerse it in water for a minute. Smooth out leather with hot iron (if too hot it will scorch or curl it); replace iron over flame, adjust the mould (previously pressed with a cloth to remove excessive water): melt sufficient plaster, either with plaster-iron or in water-bath, spread *sec. art.* Use waxed paper in loosely wrapping the finished plaster.

Vesicatoria.

"Some medical men prefer the old-fashioned blistering or cantharides plaster; others order the part to be painted with blistering fluid.

"The blistering plaster should be spread on stiff brown paper or leather, either of which is preferable to adhesive plaster, for as soon as blisters begin to rise under the plaster the adhesive border of the latter causes so much dragging pain that the patient often complains more loudly of that than of the blister itself.

Mr Tichborne.

R. Emp. Cantharid. q.s.
Mitte vesicator.

Ad aur. dext. appd.

"A pad of cotton-wool and a handkerchief or bandage will be generally enough to secure the plaster in its place" (*Manual of Nursing*, C. J. Cullingworth, M.D., 1889).

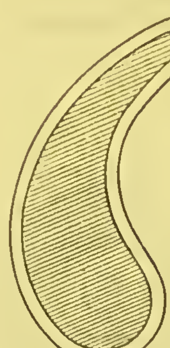


FIG. 81.—Form of blister for the left ear.

FIG. 82.—Form of blister for the right ear.

Passages selected from the *Pharmacopœia Londinensis*, 1851. [With translations of the same.]

I. Extracta.

In Extraetis præparandis, nisi aliter indieatum sit, humorem balneo aquoso in patinâ quamprimum consume, sub finem assidue spathâ movens, donec erassitudo sit ad pilulas fingendas idonea.

II. Extractum Cinchonæ.

(*Extractum Cinchonæ cordifoliæ*, *Ph.* 1836.)

℞ Cinehonæ flavæ erasse eontritæ libras tres,
Aquæ destillatæ octarios sex.

Cinchonæ adjiee Aquæ oetarios quatuor, et spathâ assiduc move donee prorsus madefaeta sit: maeera per horas viginti quatuor, et per linteum eola. Quod restat maeera in reliquâ Aquâ per horas viginti quatuor, et cola. Dein liquores in unum mixtos ad idoneam erassitudinem eonsume.

III. Pulveres.

Necesse cst, quæeunque in pulverem redigi præeepimus, ita per cribrum tenue demitti, ut separentur sordes et partes erassiores. Plerosque Pulveres oportet reeens præparari, non diu servari.

IV. Syrupus Papaveris.

℞ Papaveris eontusi demptis seminibus libras tres,
Sacehari libras quinque,
Aquæ destillatæ ferventis congios quinque.
Spiritûs rectifieati fluiduneias quinque.

Decoque Aquam eum Papavere ad eongios duos, et fortiter exprime. Liquorem eolatum iterum deeoque ad octarios quatuor, et adhue ferventem eola. Sepone per horas duodeeim, ut fæees subsidant; tum liquorem dcfæcatum dceoque ad oetarios duos; et in hoe Saeeharum liqua. Denique Spiritum admisee.

V. Unguentum Iodi Compositum.

℞ Iodi draehmam dimidiam,
Potassii Iodidi draehmam,
Spiritûs reetifieati fluidraehmam,
Adipis uneias duas.

Adipi adjiec Iodum in pulverem quam subtilissimum tritum, et Iodum in Spiritu liquatum; et tere simul.

VI. Confectio Sennæ.

℞ Sennæ uncias octo,
Ficûs libram,
Tamarindi præparati,
Cassiæ præparatæ,
Pruni præparati, singulorum libram dimidiam,
Coriandri uncias quatuor,
Glycyrrhizæ recentis contusæ uncias tres,
Sacchari libras duas cum semisse,
Aquæ destillatæ octarios tres.

Sennam cum Coriandro tere, et cribro separa pulveris mixti uncias decem. Aquam, Ficu et Glycyrrhizâ adjectis, ad dimidium decoque; deinde exprime, et cola. Liquorem colatum balneo aquoso consume, donec fluidunciæ viginti quatuor de toto restent; tum, adjecto Saccharo, fiat syrupus. Huic admisce Tamarindum Cassiam et Prunum; et paulo antequam refrixerint, adjecto paulatim pulvere cribrato, spathâ diligenter move, donec corpus unum sit.

VII. Liquor Potassæ.

℞ Potassæ Carbonatis uncias quindecim,
Calcis uncias octo,
Aquæ destillatæ ferventis congium.

Liqua Carbonatem in Aquæ congio dimidio. Calci insperge Aquæ pauxillum in vase fictili, et, resolutâ calce, reliquam Aquam adjice. Liquores inter se protinus commixtos in operto vase subinde agita, donec refrixerint. Tum sepone, ut subsidat calcis carbonas. Denique liquorem supernatantem effusum in ampullâ vitreâ viridi bene obturatâ serva.

Pondus specificum est 1·063. In granis 100 continentur potassæ grana 6·7. Nihil, aut propemodum nihil, ex hoc Liquore demittitur adjecto liquore calcis, vel, si acido nitrico prius saturatus fuerit, adjectâ vel sodæ carbonate vel barii chlorido vel argenti nitrate. Quod per platini bichloridum demittitur, subflavum est.

(Translations.)

I. Extracts.

In preparing Extracts, unless otherwise directed, evaporate the liquid, by a water-bath in a pan, as quickly as possible, constantly stirring with a spatula towards the end, until a consistence proper for forming pills is acquired.

II. Extract of Cinchona Bark.

(*Extractum Cinchonæ cordifoliæ, Ph.* 1836.)

Take of Yellow cinchona coarsely bruised, three pounds.
,, Distilled water, six pints.

Add four pints of water to the cinchona, and stir constantly with a spatula until the bark has become soaked; macerate for twenty-four hours and strain through linen. What remains macerate in the remaining water for twenty-four hours, and strain; then evaporate the mixed liquors to a proper consistence.

III. Powders.

It is necessary that whatever we order to be reduced to powder should be rubbed through a fine sieve, so that the impurities and coarser parts may be separated; and it is needful that most powders should be recently prepared, and not too long kept.

IV. Syrup of Poppy.

Take of bruised Poppies, the seeds being removed, three pounds.
,, Sugar, five pounds.
,, Boiling distilled water, five gallons.
,, Rectified spirit, five fluid ounces.

Boil down the water with the poppy to two gallons and strongly press. Again boil down the strained liquor to four pints, and strain while yet hot. Set it aside for twelve hours, that the particles may subside; then boil down the strained liquor to two pints, and in this dissolve the sugar: lastly, mix with it the spirit.

V. Compound Ointment of Iodine.

Take of Iodine, half a drachm.
,, Iodide of Potassium, a drachm.
,, Rectified spirit, a fluid drachm.
,, Lard, two ounces.

Add the iodide, reduced into the finest powder, to the lard, then the iodine dissolved in the spirit; and mix all together.

VI. Confection of Senna.

Take of Senna, eight ounces.
,, Figs a pound.
,, Prepared tamarinds.
,, Prepared cassia.
,, Prepared prunes, of each half a pound
,, Coriander, four ounces.
,, Fresh liquorice, bruised, three ounces.
,, Sugar, two pounds and a half.
,, Distilled water, three pints.

Rub the senna with the coriander, and by a sieve separate ten ounces of the mixed powder. Boil the water, with the figs and liquorice added, to half; then press and strain. Evaporate the strained liquor in a water-bath until of the whole twenty-four fluid ounces remain; then, the sugar being added, let a syrup be made. To this mix the tamarinds, cassia, and prunes, and a little before they have cooled, the sifted powder being added by degrees, stir diligently with a spatula until the whole be thoroughly incorporated.

VII. Solution of Potash.

Take of Carbonate of potash, fifteen ounces.
,, Lime, eight ounces.
,, Boiling distilled water, a gallon.

Dissolve the carbonate in half a gallon of water, sprinkle a little of the water on the lime in an earthen vessel, and the lime being slacked, add the rest of the water. The solutions being immediately mixed in a closed vessel, shake them frequently until they are cold. Then set by, that the carbonate of lime may subside. Lastly, keep the supernatant liquor, when poured off, in a well-stopped green glass vessel.

Its specific gravity is 1·063. In 100 grains there are contained 6·7 grains of potash. Nothing, or scarcely anything, is thrown down from this solution on the addition of lime-water ; nor, if it have been first saturated by nitric acid, on carbonate of soda, chloride of barium, or nitrate of silver being added, does anything fall. What is thrown down by bichloride of platinum is yellowish.

APPENDIX.

Abbreviations used in Prescriptions.

a.a. or ana	ana	of each.
Abs. feb.	absente febre	during the absence of fever.
Ad.	adde	add.
Ad def. an.	ad deficientem animam	to fainting.
Ad deliq.	ad deliquium	to fainting.
Ad gr. acid.	ad gratam aciditatem	to an agreeable acidity.
Adj.	adjice	add.
Ad. lib.	ad libitum	at will—to the desired amount.
Ad 2 vic.	ad secundam vicem ad duas vices	to the second time. for two times.
Ad us.	ad usum	according to custom.
Admov.	admoveatur	let it be applied.
Æq.	æquales	equal.
Alt. dieb.	alternis diebus	every other day.
Alt. hor.	alternis horis	every second hour.
Alv. adstrict.	alvo adstricta	the bowels being confined.
Alv. deject.	alvi dejectiones	the evacuations.
Aq.	aqua	water.
Aq. astrict.	aqua astricta	ice.
Aq. bull.	aqua bulliens	boiling water.
Aq. comm.	aqua communis	common water.
Aq. dest.	aqua destillata	distilled water.
Aq. ferv.	aqua fervens	hot or boiling water.
Aq. font.	aqua fontis	spring water.
Aq. mar.	aqua marina	salt or sea water.
Aq. niv.	aqua nivalis	snow water.
Aq. pluv.	aqua pluvialis	rain water.
B. a. or B. s.	balneum arenæ	sand bath.
B. arenæ	balneum arenæ	a sand bath.
B. m.	balneum marinum	a salt-water bath.
Bals.	balsamum	balsam.
BB. or Bbds.	Barbadensis	Barbadoes.
Bib.	bibe	drink.
Bis ind.	bis indies	twice a day.
Bis in 7 d.	bis in septem dies	twice a week.
Bol.	bolus	a large pill mass.
Bull.	bulliat	let it boil.
But.	butyrum	butter.
B. v.	balneum vaporis	vapour bath.
C.	congius ; centigrade	a gallon ; a scale of temperature.
c.	cum	with.
c.c.	contusa	bruised.

Cal.	calomel	subchloride of mercury.
Cap.	capiat	let him take.
Cels.	Celsius	a scale of temperature.
C.C.	cornu cervi	hartshorn.
C. m.	cras mane	to-morrow morning.
C. m. s.	cras mane sumendus	to be taken to-morrow morning.
C. n.	cras nocte	to-morrow night.
Co.	compositus	compound.
Cochl.	cochleare	spoonful.
Cochl. ampl.	cochleare amplum	a tablespoonful.
Coch. infant.	cochleare infantis	a teaspoonful.
Coch. mag.	cochleare magnum	a tablespoonful.
Cochl. med. or mod.	cochleare medium, seu modicum	a dessertspoonful.
Cochl. parv.	cochleare parvum	a small or teaspoonful.
Cochleat.	cochleatim	by spoonfuls.
Col.	cola	strain.
Colat.	colatus	strained.
Color.	coloretur	let it be coloured.
Comp.	compositus	compound.
Conc.	concentratus	concentrated.
Conf.	confectio	confection.
Cong.	congius	a gallon.
Cons.	conserva	conserve.
Cont.	contunde	break into small pieces.
Contin.	continuetur	let it be continued.
Cont. rem.	continuetur remedium	let the medicine be continued.
Coq.	coque	boil.
Coq. ad med. consump.	coque ad medietatis consumptionem	boil down to one-half.
Cort.	cortex	bark.
Crast	crastinus	for to-morrow.
Cuj	cujus	of which.
C. v.	cras vespere	to-morrow evening.
Cyath.	cyathus	a glassful
Cyath. vinos.	cyathus vinosus	a wine-glassful.
D.	dosis	a dose.
d.	da, detur	give.
Dearg. pil.	deargentetur pilula	let the pill be silvered.
Deaur. pil.	deauretur pilula	let the pill be gilded.
Deb. spiss.	debita spissitudo	a due consistence.
Dec.	decanta	decant.
Decub.	decubitus	lying down.
De d. in d.	de die in diem	from day to day.
Deglut.	deglutiatur	let it be swallowed.
Dej. alv.	dejectiones alvi	stools.
Dep.	depuratus	purified.
Destill.	destilla	distil.
Det.	detur	let it be given.
D. et s.	detur et signetur	let it be given and directed.
Det. in 2 plo.	detur in duplo	give in double the quantity.
Dieb. alt.	diebus alternis	on alternate days.
Dieb. tert.	diebus tertiis	every third day.

Dig.	digeratur	let it be digested.
Dil.	dilue	let it be dissolved.
Diluc.	diluculo	at break of day.
Dilut.	dilutus	dilute.
Dim.	dimidius	one-half.
Dist.	distilla	distil.
Div.	divide	divide.
D. in p. æ.	divide in partes æquales	divide into equal parts.
Donec alv. sol. fuerit	donec alvus soluta fuerit	until the bowels be open.
D. p.	directione propria	with a proper direction.
Dr. or Drach.	drachma	a drachm.
D. t. d.	detur tales doses	send —— doses.
Ed.	edulcora	sweeten.
Ejusd.	ejusdem	of the same.
Elect.	electuarium	electuary.
Enem.	enema	enema.
Exhib.	exhibeatur	let it be given.
Ext. sup. alut.	extende super alutam	spread upon leather.
F. or Ft.	fac; fiat	make; let it be made.
F. or Fahr.	Fahrenheit	a scale of temperature.
Fasc.	fasciculus	a bundle.
Feb. dur.	febre durante	the fever continuing.
Fem. intern.	femoribus internis	to the inside of the thighs.
F. h.	fiat haustus	make a draught.
F. l. a.	fiat lege artis	according to rule.
Fict.	fictilis	made of pottery.
Filt.	filtra	filter.
Fl.	fluidus; flores	fluid or flowers.
F. m.	fiat mistura	make a mixture.
Fol.	folia	leaves.
F. p.	fiat potio	make a potion.
F. pil.	fiat pilula	make a pill.
Fract. dos.	fractis dosibus	in divided doses.
Fruct.	fructus	fruits.
Frust.	frustillatim	in small pieces.
F. s. a.	fiat secundum artem	let it be done skilfully.
F. VS. or Ft. venæs.	fiat venæsectio	bleed.
Gel. quav.	gelatina quâvis	in any kind of jelly.
G. g. g.	gummi guttæ gambæ	gamboge.
Gr.	granum	grain.
Gum.	gummi	gum.
Gutt. or Gtt.	gutta or guttæ	drop or drops.
Guttat.	guttatim	by drops.
Habt.	habeat	let him have.
Har.	harum	of them.
Haust. purg.	haustus purgans	a purging draught.
H. p.	haustus purgans	a purgative draught.
Hor. decub.	hora decubitus	at bedtime.
Hor. intermed.	horis intermediis	at intermediate hours.
Hor. un. spat.	horæ unæ spatu	in an hour's time.
H. s.	hora somni	at bedtime.
Ind.	indies	daily.
Inf.	infunde	to infuse.
Inj.	injectio	an injection.
Inj. enem.	injiciatur enema	let a clyster be given.

In. pulm.	in pulmento	in gruel.
Jul.	julepum	julep.
Lat. dol.	lateri dolenti	to the painful side.
L. a.	lege artis	according to art.
Lb.; lib.	libra; liber	a pound; a book.
Lin.	linimentum	liniment.
Liq.	liquor	liquor.
M.	misce	mix.
M. d. s.	misce detur signetur	mix and let be given and labelled.
Mac.	macera	macerate.
Man.	manipulus	a handful.
Man. prim.	mane primo	early in the morning.
Mic. pan.	micæ panis	crumb of bread.
M. p.	massa pilularum	pill mass.
Mass. pil.	massa pilularum	pill mass.
Min.	minimum	a minim, one-sixtieth of a drachm.
Mit.	mitte	send.
Mitt. sang.	mittatur sanguis	let blood be drawn.
Mod. præscript.	modo præscripto	in the manner directed.
Mor. dict.	more dicto	in the manner directed.
Mor. sol.	more solito	in the usual way.
Muc.	mucilago	mucilage.
N. m.	nux moschata	a nutmeg.
No.	numero	number.
Noct.	nocte	by night.
O.	octarius	a pint.
Ol.	oleum	oil.
Oll.	olla	a pot.
Ol. lin. s. i.	oleum lini sine igne	cold drawn linseed oil.
Ol. oliv.	oleum olivæ	olive oil.
O. m.	omni mane	every morning.
Om. man.	omni mane	every morning.
Omn. bid.	omni biduo	every two days.
Omn. bih.	omni bihorâ	every two hours.
Omn. hor.	omni horâ	every hour.
Om. noct.	omni nocte	every night.
O. n.	omni nocte	every night.
O. quad. hor.	omni quadrante horæ	every quarter of an hour.
Ov.	ovum	egg.
Ox.	oxymel	honey and vinegar.
Oz.	uncia	an ounce.
P. or Pt.	perstetur	continue.
Part. æq.	partes æquales	equal parts.
P. æ.	partes æquales	equal parts.
Part. vic.	partitis vicibus	in divided doses.
Past.	pastilla	pastille.
P. Bor.	Pharmacopœia Borussica	Prussian Pharmacopœia.
P. B.	Pharmacopœia Britannica	British Pharmacopœia.
P. D.	Pharmacopœia Dublinensis	Dublin Pharmacopœia.
P. E.	Pharmacopœia Edinensis	Edinburgh Pharmacopœia.
P. E.	pars equalis	an equal part.
Peract op. emet.	peracta operatione emetici	the action of the emetic having finished.

P. G.	Pharmacopœia Germanica	German Pharmacopœia.
Pil.	pilula	pill.
P. L.	Pharmacopœia Londinensis	London Pharmacopœia.
Pocill.	pocillum	a small cup.
Pocul.	poculum	a cup.
P. or Pond.	pondere	by weight.
Post sing. sed. liq.	post singulas sedes liquidas	after each fluid evacuation.
Pot.	potio ; potassium	potion ; potassium.
Ppt.	præparata	prepared.
P. rat. æt.	pro rata ætatis	in proportion to the age.
P. r. n.	pro re natâ	when required.
Pugil.	pugillus	a large pinch.
Pulv.	pulvis	powder.
P. U. S.		United States Pharmacopœia.
Q. l.	quantum libet	as much as is requisite.
Q. P.	quantum placet	at will.
Q. P.	quantum placeat	as much as may please.
Q. S.	quantum satis ; quantum sufficit	a sufficient quantity.
Quor.	quorum	of which.
Q. v.	quantum volueris	at will.
R.	recipe	take.
Rad.	radix	root.
Ras.	rasuræ	shavings.
Ré.	Réaumur	degree of Réaumur's thermometer scale.
Rect.	rectificatus	rectified.
Red. in pulv.	redactus in pulverem	reduced to powder.
Redig. in pulv.	redigatur iu pulverem	let it be powdered.
Reg. umbil.	regio umbilici	the umbilical region.
Rep.	repetatur	let it be repeated.
S.	signa	give directions; label.
S. a.	secundum artem	skilfully.
Scat.	scatula	a box.
Sem.	semen	seed.
Semi-dr.	semidrachma	half a drachm.
Semi-hor.	semihora	half an hour.
Serv.	serva	preserve.
Sesunc.	sesuncia	an ounce and a half.
Sig.	signetur	let it be labelled.
Sig. n. pr.	signa nomine proprio	label with its common name.
Sing.	singulorum	of each.
Si non val.	si non valeat	if it does not answer.
Si op. sit	si opus sit	if requisite.
Solv.	solve	dissolve.
Sp. or Spir. or Spt.	spiritus	spirit.
S. q.	satis quantum	sufficient.
S. s.	semis, semissis (Gen.)	one-half.
S. s. s.	stratum super stratum	layer upon layer.
St.	stet	let it stand.
Subt.	subtilis	fine.
Sum.	sumat or sumendum	let him take. let it be taken.

Summ.	summitates	the tops.
Sum. tal.	sumat talem	let a similar one be taken.
S. v. r.	spiritus vini rectificatus	rectified spirit of wine.
S. v. t.	spiritus vini tenuior	proof spirit.
Syr.	syrupus	syrup.
T.	transcribe	transcribe.
Tab.	tabellæ	tablets.
T. d.	ter in die	three times a day.
Temp. dext.	tempori dextro	to the right temple.
Temp. sinist.	tempori sinistro	to the left temple.
Ter.	tere	triturate.
T. O.	tinctura opii	tincture of opium.
T. o. c.	tinctura opii camphorata	camphorated tincture of opium.
Tr., Tra., and Tinct.	tinctura	tincture.
Trit.	tritura	triturate.
U. ad deliq.	usque ad deliquium	to fainting.
Ult. præscript.	ultimum præscriptum	last prescribed.
Unc.	uncia	an ounce.
Ung.	unguentum	ointment.
V.	vitrum	glass.
Ves.	vesica	the bladder.
Vesic.	vesicatorium	a blister.
Vit. ov.	vitellus ovi	yolk of egg.
Vom. urg.	vomitu urgente	the vomiting being severe.
V. o. s.	vitello ovi solutus	dissolved in the yolk of an egg.
V. s.	venæsectio	venæsection.
V. s. b.	venæsectio brachii	bleeding from the arm.

℞	Recipe.	ss or β	Semis.
℔	Libra (Troy, Apoth.).	△	Aqua.
℥	Uncia.	XX	Crystalli.
ʒ	Drachma.	ff	Saccharum.
℈	Scrupulus.		

Vocabulary of Words commonly occurring in Latin Pharmaceutical Writings.

A, ab, or abs, Prep., by or from (abl.).
Aa, ana (indecl.), of each.
Absque, Prep., without (abl).
Absum, abfui, abesse, to be absent.
Acacia, æ, F., acacia.
Acer, acris, acre, Adj., keen, sharp.
Acetas, acetatis, M., acetate.
Acetum, i, N., vinegar.
Acidus, a, um, Adj., acid.
Ad, Prep., to (accus.).
Adeps, adipis, M., lard.
Adhibeo, ui, itum, ere, II., to use, employ, take.
Admoveo, movi, motum, ere, II., to move to, to apply.

$\left.\begin{array}{l}\text{Adstringo}\\\text{Astringo}\end{array}\right\}$ nxi, ictum, ingere, III., to bind.
Adsum, affui, adesse, to be present.
Æger, ægra, ægrum, Adj., sick (the patient).
Æther or Ether, eris, ether.
Affecto, avi, atum, are, I., to affect.
Afficio, feci, fectum, ficere, III., to affect, to touch.
Ago, egi, actum, agere, III., to do, to act.
Albus, a, um, white.
Alnus, i, F., the alder.
Aloë, ës, F., the aloe.
Alumen, inis, N., alum.
Aluta, æ, leather.
Alvus, i, F., II., the belly (the bowels).
Ambo, æ, o, Adj., both.
Ammonia, æ, F., ammonia.
Amplus, a, um, Adj., full ; cochleare amplum, a tablespoonful.
Amygdala, æ, F., the almond.
Amygdalus, i, the almond tree.
Ante, Prep., before (accus.).
Antimonium, ii, N., antimony.
Aperiens, entis, Part., aperient, from aperio, to open.
Apis, is, F., a bee.
Applico, avi, and ui, atum, are, I., to apply.
Aqua, æ, F., water.
Aquosus, a, um, Adj., watery.
Argenteus, a, um, Adj., silvery, of silver.
Argentum, i, N., silver.
Aromaticus, a, um, Adj., aromatic.
Ars, artis, F., art.
Arsenias, atis, M., arseniate.
Asellus, i, M., the cod.
Asper, a, um, Adj., rough.
Ater, atra, atrum, Adj., black.
Aurantium, ii, M., the orange.
Auratus, a, um, Adj., golden ; also aurantiacus, orange-golden.
Aureus, a, um, Adj., golden.
Auris, is, F., the ear.
Aurum, i, N., gold.
Aut, Conj., or.
Avellana, "nucis avellanæ magnitudo" the size of a filbert.
Balneum, a bath.
Barbadensis, e, Adj., of or from Barbadoes.
Benzoas, atis, M., benzoate.
Bibo, bibi, bibere, III., to drink.
Bicarbonas, atis, M., bicarbonate.
Bis, Adv., twice.
Bos, bovis, M., an ox.
Bovinus, a, um, Adj., pertaining to an ox.
Brachium, ii., N., the arm.
Brevis, breve, Adj., short.
Cæterus, a, um, Adj., the other, the rest.
Calidus, a, um, Adj., warm.
Calomelas, anos (also indecl.), M., calomel.
Calor, oris, M., heat.

Calumba, æ, F., calumba.
Camphora, æ, F., camphor.
Cantharis, idis, F., blister fly, a genus of beetles.
Capillus, i, M., a hair.
Capio, cepi, captum, capere, III., to take.
Caput, itis, N., the head.
Carbonas, atis, M., carbonate.
Cardamomum, i, N., cardamom.
Cascarilla, æ, F., cascarilla.
Cassia, æ, F., cassia.
Castanea, æ, F., chestnut.
Cataplasma, atis, N. a poultice.
Ceratum, i, N., a cerate.
Charta, æ, F., a paper.
Chloras, atis, M., chlorate.
Chloricus, a, um, Adj., chloric.
Chloroformum, i, N., chloroform.
Cinchona, æ, F., cinchona.
Cinnamomum, i, N., cinnamon.
Circa, circum, Prep., around (accus.).
Citras, atis, M., citrate.
Citricus, a, um, Adj., citric.
Cochleare, is, N., a spoonful.
Cœna, æ, F., supper.
Colchicum, i, N. colchicum.
Collyrium, ii, N., an eye lotion.
Colo, avi, atum, are, I., to strain.
Colo, colui, cultum, colere, III., to cultivate.
Colocynthis, idis, F., colocynth.
Color, oris, M., colour.
Compositus, a, um, Adj., compound.
Concido, cidi, cisum, cidere, III., to cut up, slice.
Confectio, onis, F., confection.
Conserva, æ, F., a conserve.
Conservo, avi, atum, I., to keep.
Contra, Prep., against, contrary to (acc).
Contundo, tudi, tusum, tundere, III., to pound, bruise.
Contusus, a, um, Part., pounded.
Convalesco, lui, scere, III., to get better.
Coquo, coxi, coctum, coquere, III., to cook, to boil.
Cornu, ûs, N., horn.
Corrigo, rexi, rectum, rigere, III., to correct.
Cras, Adv., to-morrow.
Creta, æ, F., chalk.
Croton tiglium, gen. crotonis tiglii. Croton-seed.
Crus, cruris, N., the leg.
Cubo, ui, itum, are, I., to lie down.
Cum, Prep., with (abl.).
Cuprum, i, N., copper.
Curo, avi, atum, are, I., to cure.
Cyathus, M., a cup, C. vinarius, a wine glass.
Decoctum, i, N., a decoction.
Deinde, Adv., then, next.
Deligo, delegi, delectum, deligere, III., to select, to choose out.
Destillatio, onis, F., distillation.
Destillo, avi, atum, are, I., to distil.

Dexter, era, erum, and tra, trum, Adj., right.
Digitus, i, M., a finger.
Dimidium, ii, N., the half.
Dimidius, a, um, Adj., half.
Dirigo, direxi, directum, dirigere, III., to direct.
Disulphas, atis, M., disulphate.
Divido, visi, visum, ere, III., to divide.
Do, dedi, datum, dare, I., to give.
Dolor, oris, M., pain.
Donec, Adv., until.
Dosis, is (accusative dosim), F., a dose.
Drachma, æ, F., gen. plural drachmum, a drachm.
Dulcis, dulce, Adj., sweet.
Effervescentia, æ, F., effervescence.
Electuarium, ii., N., electuary.
Emplastrum, tri, N., a plaster.
Enema, atis, N., a clyster.
Exhibeo, ui, itum, ere, II., to exhibit.
Expers, expertis, Adj., free from.
Externus, a, um, Adj., outside ; comp. exterior ; superl. extremus.
Extractum, i, N., an extract.
Facies, ei, F., the face.
Facio, feci, factum, facere, III., imperat. fac., to make.
Febricula, æ, F., fever.
Febris, is, F., a fever ; accus. febrem, febrim ; abl. febri.
Fel, fellis, N., gall.
Ferrum, i, N., iron.
Ficus, ûs, F., a fig.
Fio, factus sum, fieri (pass. of facio), to be made, to become.
Flatus, us, M., breathing, flatulence.
Flavus, a, um, Adj., yellow.
Flos, floris, M., a flower.
Fœtidus, a, um, Adj., fœtid.
Folium, ii, N., a leaf.
Fraxinus, i, F., the ash-tree.
Frigidus, a, um, Adj., cold.
Galbanum, i, N., galbanum.
Gallicus, a, um, Adj., Gallic.
Gallus, i, M., subs. a cock (fem. gallina, æ, a hen).
Gargarisma, atis, N., gargle.
Gentiana, æ, F., gentian.
Glycyrrhiza, æ, F., liquorice.
Gramen, inis, N., grass.
Granum, i, N., a grain.
Gutta, æ. F., a drop.
Habeo, ui, itum, bere, II., to have.
Haustus, ûs, M., a draught.
Heri, Adv., yesterday.
Hirudo, hirudinis, F., a leech.
Hodie, Adv., to-day.
Hydrargyrum, i, N., mercury.
Hydras, atis, M., hydrate.
Hydrochloras, atis, M., hydrochlorate.
Hyoscyamus, i, M., henbane.
Hydrocyanicus, a, um, Adj., hydrocyanic.
Hyposulphis, itis, M., hyposulphite.

Idem, eadem, idem, the same.
Idoneus, a, um, Adj., proper.
Ignis, is, M., fire.
Imminuo, ui, utum, uere, III., to diminish.
Impono, osui, ositum, ere, III., to plaee upon.
Imus, a, um, Adj., lowest; superl., from inferus.
Infra, Prep., below (aeeus.).
Infrieo, ui, atum, are, I., to rub in.
Infuso, avi, atum, are, I., to infuse.
Infusum, i, N., an infusion.
Inspisso, avi, atum, are, I., to inspissate, thieken.
Inter, Prep., between, among (aecus.).
Interdum, Adv., sometimes, now and then, meanwhile.
Interus, a, um, Adj., inside; eomp. interior; superl. intimus.
Intime, Adv., intimately, thoroughly.
Intra, Prep., inside of, within (accus.).
Involvo, vi, volutum, ere, III., to roll in.
Iodidum, i, N., Iodide.
Ipeeaeuanha, æ, F.
Jamaieensis, e, Adj., of or belonging to Jamaiea.
Jeeur, jeeoris, N., the liver.
Lae, lactis, N., milk.
Latus, a, um, Adj., broad.
Latus, eris, N. subs., the side.
Laxativus, a, um, Adj., laxative.
Lenitivus, a, um, Adj., lenitive.
Levis, leve, Adj., light, smooth, gentle, gradual.
Libet, libuit, and libitum est, libere, to please, it pleases.
Libra, æ, F., a pound.
Lignum, i, N., wood.
Limon, onis, F., lemon.
Linimentum, i, N., a liniment.
Liquidus, a, um, Adj., liquid.
Liquor, liquoris, M., a fluid.
Lotio, onis, F., a lotion.
Lytta, æ, F., Spanish fly.
Maeero, avi, atum, are, I., to macerate.
Magis, Adv., more.
Magnesia, æ, F., magnesia.
Magnitudo, inis, F., size.
Magnus, a, um., Adj., great; comp. major; superl. maximus.
Malus, a, um., Adj., bad.
Mane, N, indeel. subs., used adverbially; in the morning.
Massa, æ, F., a mass.
Medieamentum, i, N., a medieine, a drug.
Medius, a, um, Adj., intermediate; eoehleare medium, a dessertspoonful.
Mentha, æ, F., mint.
Mereurius, ii, M., mereury.
Meridies, M., noon.
Minimum, i, a minim (derived from minimum, the least).
Miseeo, miseui, mistum or mixtum, miscere, II., to mix.
Mistura, æ, F., a mixture.
Mitis, e, Adj., mild.
Mitto, misi, missum, mittere, III., to send.
Modo, Adv., only.
Modus, i, M., manner, way.

Mollis, e, Adj., soft.
Morbus, i, M., disease.
Morphina, æ, F., morphina.
Morrhua, æ, F., cod.
Moschata, æ, F., a nutmeg.
Mucilago, inis, F., mucilage.
Muto, avi, atum, are, I., to change.
Myrrha, æ, F., myrrh.
Niger, ra, rum, Adj., black.
Nimis, Adv., too much.
Nisi, Conj., unless.
Nitras, atis, M., nitrate.
Nitris, itis, M., nitrite.
Nitrosus, a, um, Adj., nitrous.
Nox, noctis, F., subs., night.
Nux, nucis, F., a nut.
Nycthemerum, i, N., a night and a day, *i.e.*, twenty-four hours.
Octarius, ii, M., a pint.
Oculus, i, M., an eye.
Odor, oris, M., a scent.
Oleum, ei, N., oil.
Oliva, æ, F., the olive.
Opium, ii, N., opium.
Optimus, a, um. Adj., best, superl.; from bonus, good.
Orior, ortus sum, oriri, V., to rise.
Ornus, i, F., mountain ash.
Ovis, is, F., a sheep.
Par, paris, Adj., equal.
Paro, avi, atum, are, I., to prepare.
Paroxysmus, i, M., paroxysm.
Pars, partis, F., a part.
Parvus, a, um, Adj., small.
Patior, passus sum, pati, III., to suffer.
Pauxillum, i, N., a little.
Pectus, oris, N., the breast (the chest).
Pendens, pendentis, Part., weighing.
Pendeo, pependi, pensum, pendere, III., to hang.
Per, Prep., through, during (accus.).
Pereo, perii, peritum, perire, IV., to perish.
Pes, pedis, M., a foot.
Pharmacopœia, æ, F.
Phosphas, atis, M., phosphate.
Phosphoricus, a, um., Adj., phosphoric.
Pilula, æ, a pill.
Piperita, æ, F., peppermint.
Pirus, i, F., the pear tree.
Plumbum, i, N., lead.
Podophyllum, i, N., podophyllum.
Pollex, icis, M., the thumb.
Ponderosus, a, um, Adj., heavy.
Pone, Prep., behind (accus.).
Populus, i, M., the people.
Post, Prep., after (accus.).
Postea, Adv., afterwards.
Posterus, a, um, Adj., behind.
Potassa, æ, F., potash.

Præ, Prep., before, in comparison with (abl.).
Præparo, ari, atum, are, I., to prepare.
Præter, Prep., besides (accus.).
Prandeo, prandi, and pransus sum, prandere, II., to dine.
Prandium, ii, N., dinner.
Pro, Prep., for, before, on behalf of (abl.); pro re nata, used adverbially; occasionally.
Prope, Prep., near (accus.).
Propter, Prep., on account of (accus.).
Prorsus, Adv., entirely.
Prunus, i, F., the plum tree.
Pulpa, æ, F., pulp.
Pulvis, pulveris, M., a powder.
Purificatus, a, um, purified.
Quantitas, atis, F., quantity.
Quercus, ûs, F., an oak.
Quies, etis, F., sleep.
Quinina, æ, and quinia, æ, F., quinine.
Quisque, quæque, quodque, each.
Radix, radicis, F., a root.
Recipio, cepi, ceptum, cipere, III., to receive, to take.
Redeo, redii, reditum, redire, IV., to return.
Refero, retuli, relatum, referre, III., to put back, relegate.
Rejicio, eci, ectum, cere, III., to reject.
Repeto, ivi, and ii, itum, ere, III., to repeat, recommence.
Resina, æ, F., resin.
Rheum, i, N., rhubarb.
Rhœas, ados, red poppy.
Rosa, æ, F., a rose.
Rotundus, a, um, Adj., round.
Rursus, Adv. again.
Saccharum, i, N., sugar.
Sæpe, Adv., often.
Sal, salis, M., salt.
Saluber, salubris, salubre, Adj., healthy.
Sapo, onis, M., soap.
Sarsaparilla, æ,
Sarza, æ, } F., sarsaparilla.
Saturnus, i, lead.
Scammonium, i, N., the gum-resin; scammonia, æ, F., scammony (plant).
Scrupulus, i, M., a scruple.
Secundum, Prep., following, in accordance with (accus.).
Sed, Conj., but.
Semel, Adv., once.
Semen, inis, N., a seed.
Semis, issis, N., one-half.
Separatim, Adv., separately.
Sepono, posui, positum, ponere, III., to set aside (to allow to settle).
Sesqui, Adv., more by one-half; one and a half.
Sesquicarbonas, atis, M., sesquicarbonate.
Signo, avi, atum, are, I., to sign, describe.
Similis, e, Adj., like.
Simul, Adv., together.
Sine, Prep., without (abl.).
Singulus, a, um, Adj., each, single.
Sitis, is, F., thirst.

Soda, æ, F., soda.
Soleo, solitus sum, solere, II., to be accustomed.
Solvo, solvi, solutum, solvere, III., to loosen, dissolve.
Spiritus, ûs, M., spirit.
Spisso, avi, atum, are, I., to thicken.
Stannum, i, N., tin.
Statim, Adv., immediately.
Sternum, i, N., the breast bone (the chest).
Stibium, ii, N., antimony.
Styrax, styracis, M., storax.
Sub., Prep., up to, under, beneath, about (acc. or abl.).
Subinde, Adv., frequently.
Submurias, atis, M., subchloride.
Succus, i, M., juice.
Sulphas, atis, M., sulphate.
Sulphis, itis, M., sulphite.
Sulphur, uris, N., sulphur.
Sulphuretum, i, N., sulphuret.
Sulphuricus, a, um, Adj., sulphuric.
Super, Prep., over (accus. or abl.).
Syrupus, i, M., syrup
Talis, e, Adj., such.
Tantus, a, um, Adj., so much.
Taraxacum, i, N., taraxacum.
Tartaricus, a, um, Adj., tartaric.
Tartras, atis, M., tartrate.
Tempus, oris, N., time; also the temple (forehead), usually tempora.
Tenus, Prep., reaching to, as far as (abl.).
Ter, Adv., thrice.
Thorax, acis, M., the chest, thorax.
Tinctura, æ, F., a tincture.
Totus, a, um, Adj., so many.
Tragacantha, æ, F., tragacanth.
Tussis, is, F., a cough (acc. tussim; abl. tussi).
Ulmus, i, F., the elm.
Uncia, æ, F., an ounce.
Unguentum, i, N.. ointment.
Usus, ûs, M., use.
Valerianas, atis, M., valerianate.
Ve, enclitic Conj., or.
Vel, Conj., or.
Vena, æ, F., a vein.
Venenum, i, N., poison.
Veratria, æ, F., veratria.
Versus, Prep., towards (put after governed word), acc.
Vesicatorius, a, um, Adj., pertaining to a blister.
Vesicatorium, i, N., a blister.
Vesper, eris, M., subs. the evening; vespero or vesperi, in the evening.
Vices, F., subs. defect., timo, times; ad tres vices, threo times successively.
Vinum, i, N., wine.
Virus, i, N., poison.
Vomicus, a, um, Adj., producing sickness.
Vomitus, a, um, Adj., vomiting.
Vulgo, Adv., commonly.
Vulnus, eris, N., a wound.
Zingiber, eris, N., ginger.

LATIN NUMERALS.

From *quattuor* to *centum* are indeclinable.

Arabic Symbols.	Roman Symbols.	Cardinals.	Ordinals.
1	I	unus	primus.
2	II	duo	secundus or alter.
3	III	tres	tertius.
4	IV	quattuor	quartus.
5	V	quinque	quintus.
6	VI	sex	sextus.
7	VII	septem	septimus.
8	VIII	octo	octavus.
9	IX	novem	nonus.
10	X	decem	decimus.
11	XI	undecim	undecimus.
12	XII	duodecim	duodecimus.
13	XIII	tredecim	tertius decimus.
14	XIV	quattuordecim	quartus decimus.
15	XV	quindecim	quintus decimus.
16	XVI	sedecim	sextus decimus.
17	XVII	septemdecim	septimus decimus.
18	XVIII	duodeviginti	duodevicesimus.
19	XIX	undeviginti	undevicesimus.
20	XX	viginti	vicesimus.
21	XXI	unus et viginti *or* viginti unus	primus et vicesimus, *or* vicesimus primus.
22	XXII	duo et viginti *or* viginti duo	alter et vicesimus, *or* vicesimus alter.
23	XXIII	tres et viginti *or* viginti tres	tertius et vicesimus, *or* vicesimus tertius.
28	XXVIII	duodetriginta	duodetrigesimus.
29	XXIX	undetriginta	undetrigesimus.
30	XXX	triginta	trigesimus.
40	XL	quadraginta	quadragesimus.
50	L	quinquaginta	quinquagesimus.
60	LX	sexaginta	sexagesimus.
70	LXX	septuaginta	septuagesimus.
80	LXXX	octoginta	octogesimus.
90	XC	nonaginta	nonagesimus.
100	C	centum	centesimus.
200	CC	ducenti (ae, a)	ducentesimus.
300	CCC	trecenti	trecentesimus.
400	CCCC	quadringenti	quadringentesimus.
500	D *or* IↃ	quingenti	quingentesimus.
600	DC	sexcenti	sexcentesimus.
700	DCC	septingenti	septingentesimus.
800	DCCC	octingenti	octingentesimus.
900	DCCCC	nongenti	nongentesimus.
1000	M *or* CIↃ	mille	millesimus.
2000	MM	duo millia	bis millesimus.
100,000	CCCIↃↃↃ	centum millia	centies millesimus.

ALCOHOL TABLES.[1]

Percentage.		Specific Gravity, 15°·5 C.	Percentage Under Proof (Approximate Number).	Percentage.		Specific Gravity, 15°·5 C.	Percentage Under Proof (Approximate Number).
By Weight.	By Volume.			By Weight.	By Volume.		
		1·0000			26	0·9698	
	1	0·9985				0·9693	
1		0·9981		22	27	0·9691	
	2	0·9970				0·9683	
2		0·9965		23	28	0·9678	50
	3	0·9956	95			0·9671	
3		0·9947		24	29	0·9665	
	4	0·9942				0·9658	
4	5	0·9930		25	30	0·9652	48
5	6	0·9914	90			0·9645	
6	7	0·9898			31	0·9643	46
	8	0·9890		26		0·9638	
7		0·9884	85		32	0·9631	44
	9	0·9878		27		0·9623	
8	10	0·9869			33	0·9618	42
9	11	0·9855	80	28	34	0·9609	40
10	12	0·9841				0·9602	
11	13	0·9828				0·9595	
	14	0·9821		29	35	0·9593	
12	15	0·9815	75			0·9587	38
13	16	0·9802		30	36	0·9578	
		0·9794				0·9572	36
14	17	0·9789	70		37	0·9565	
		0·9784		31		0·9560	
15	18	0·9778				0·9555	34
		0·9775			38	0·9550	
		0·9772		32		0·9544	32
16	19	0·9766	65			0·9539	
	20	0·9760			39	0·9535	
17	21	0·9753		33		0·9528	
		0·9749			40	0·9519	30
		0·9743		34		0·9511	
18	22	0·9741			41	0·9503	28
		0·9737	60			0·9495	
		0·9732		35	42	0·9490	26
19	23	0·9728				0·9475	
		0·9720		36	43	0·9470	
20	24	0·9716				0·9465	24
		0·9714		37	44	0·9452	
	25	0·9709				0·9446	22
21		0·9704	55	38	45	0·9434	20

[1] The main portion of the following tables (as revised by Dr E. R. Squibb) has recently appeared in *Remington's Pharmacy*.

ALCOHOL TABLES—*continued.*

Percentage.		Specific Gravity, 15°·5 C.	Percentage Under Proof (Approximate Number).	Percentage.		Specific Gravity, 15°·5 C.	Percentage Under Proof (Approximate Number).
By Weight.	By Volume.			By Weight.	By Volume.		
		0·9426				0·9318	10
39	46	0·9416		44		0·9314	
		0·9405	18			0·9306	
40	47	0·9396			52	0·9303	
		0·9391		45		0·9292	8
	48	0·9381	16		53	0·9283	
41		0·9376		46		0·9270	6
		0·9373			54	0·9262	
	49	0·9362	14	47		0·9249	4
42		0·9356			55	0·9242	
		0·9352				0·9236	
	50	0·9343	12	48		0·9228	2
43		0·9335			56	0·9221	
		0·9329				0·9212	
	51	0·9323		49		0·9206	

Percentage.		Specific Gravity.	Percentage Over Proof (Approximate Number).	Percentage.		Specific Gravity.	Percentage Over Proof (Approximate Number).
By Weight.	By Volume.			By Weight.	By Volume.		
	57	0·9200		60		0·8956	
50		0·9184			68	0·8949	
	58	0·9178	2	61		0·8932	20
51	59	0·9160			69	0·8925	
		0·9150	4			0·8910	22
52	60	0·9135		62		0·8908	
		0·9124	6		70	0·8900	
53	61	0·9113				0·8897	
		0·9100	8	63		0·8886	24
54	62	0·9090			71	0·8875	
		0·9075	10	64		0·8863	
55	63	0·9069			72	0·8850	26
		0·9062		65		0·8840	
56	64	0·9047	12		73	0·8825	28
		0·9036		66		0·8816	
57	65	0·9025	14		74	0·8799	30
58	66	0·9001		67		0·8793	
59		0·8979	16	68	75	0·8769	32
	67	0·8973		69	76	0·8745	
		0·8966	18			0·8739	34

ALCOHOL TABLES—*continued.*

Percentage.		Specific Gravity.	Percentage Over Proof (Approximate Number).	Percentage.		Specific Gravity.	Percentage Over Proof (Approximate Number).
By Weight.	By Volume.			By Weight.	By Volume.		
70	77	0·8721		85		0·8357	
71	78	0·8696			90	0·8340	
		0·8678	38			0·8336	58
72		0·8672		86		0·8331	
	79	0·8664				0·8317	
73		0·8649	40	87	91	0·8305	
	80	0·8639				0·8298	60
74		0·8625		88		0·8279	
	81	0·8611	42		92	0·8272	
75		0·8603				0·8259	62
		0·8599		89		0·8254	
76	82	0·8581	44		93	0·8237	
		0·8566		90		0·8228	64
77	83	0·8557	46	91	94	0·8199	65
		0·8539		92		0·8172	
78		0·8533			95	0·8164	67
	84	0·8526		93		0·8145	
		0·8516	48		96	0·8125	
79		0·8508		94		0·8118	
	85	0·8496		95		0·8089	
80		0·8483	50		97	0·8084	
	86	0·8466		96		0·8061	
81		0·8459	52		98	0·8041	
82	87	0·8434		97		0·8031	
		0·8415	54	98		0·8001	
83	88	0·8408			99	0·7995	
		0·8396		99		0·7969	
84		0·8382	56			0·7946	
	89	0·8373		100	100	0·7938	

The term "proof" was originally intended to denote spirit that was just strong enough to ignite gunpowder when burnt upon it, but it was legally defined in the reign of George III. as "spirit such as shall at the temperature of 51° F. weigh exactly twelve-thirteenth parts of an equal amount of distilled water." Such spirit possesses a specific gravity of ·920. "Rectified spirit" possesses a sp. gr. of ·838, and is called 56 per cent. O.P. (*over proof*), *i.e.*, 100 volumes contain as much spirit as is contained in 156 vols. of proof spirit. To approximately reduce an "over proof" spirit (say 65 O.P.) to "proof," add to 100 vols. of such spirit sufficient water to produce 165 vols. To raise an "under proof" spirit (say 17 U.P.) to proof, add to 100 vols. of such spirit sufficient rectified spirit to produce 117 vols.

Beer contains from 2 to 6 per cent. alcohol; *Clarets*, *Hock*, 8 to 10 per cent.; *Ports and Sherries*, 15 to 20 per cent.; *Spirits* (*Whisky*, &c.), 51 to 54 per cent.; *Liqueurs* are the latter sweetened and mixed with aromatic substances (essential oils, &c.).

THERMOMETER.

Comparison between the Scales of Fahrenheit, Réaumur, and the Centigrade.

ZERO FAHRENHEIT CORRESPONDS WITH *minus* 17·78 CENTIGRADE AND *minus* 14·22 REAMUR.

CENT.	FAH'T.	RMR.	CENT.	FAH'T.	RMR.	CENT.	FAH'T.	RMR.
°	°	°	°	°	°	°	°	°
100	212	80	60	140	48	20	68	16
99	210·2	79·2	59	138·2	47·2	19	66·2	15·2
98	208·4	78·4	58	136·4	46·4	18	64·4	14·4
97	206·6	77·6	57	134·6	45·6	17	62·6	13·6
96	204·8	76·8	56	132·8	44·8	16	60·8	12·8
95	203	76	55	131	44	15	59	12
94	201·2	75·2	54	129·2	43·2	14	57·2	11·2
93	199·4	74·4	53	127·4	42·4	13	55·4	10·4
92	197·6	73·6	52	125·6	41·6	12	53·6	9·6
91	195·8	72·8	51	123·8	40·8	11	51·8	8·8
90	194	72	50	122	40	10	50	8
89	192·2	71·2	49	120·2	39·2	9	48·2	7·2
88	190·4	70·4	48	118·4	38·4	8	46·4	6·4
87	188·6	69·6	47	116·6	37·6	7	44·6	5·6
86	186·8	68·8	46	114·8	36·8	6	42·8	4·8
85	185	68	45	113	36	5	41	4
84	183·2	67·2	44	111·2	35·2	4	39·2	3·2
83	181·4	66·4	43	109·4	34·4	3	37·4	2·4
82	179·6	65·6	42	107·6	33·6	2	35·6	1·6
81	177·8	64·8	41	105·8	32·8	1	33·8	0·8
80	176	64	40	104	32	Zero	32	Zero
79	174·2	63·2	39	102·2	31·2	1	30·2	0·8
78	172·4	62·4	38	100·4	30·4	2	28·4	1·6
77	170·6	61·6	37	98·6	29·6	3	26·6	2·4
76	168·8	60·8	36	96·8	28·8	4	24·8	3·2
75	167	60	35	95	28	5	23	4
74	165·2	59·2	34	93·2	27·2	6	21·2	4·8
73	163·4	58·4	33	91·4	26·4	7	19·4	5·6
72	161·6	57·6	32	89·6	25·6	8	17·6	6·4
71	159·8	56·8	31	87·8	24·8	9	15·8	7·2
70	158	56	30	86	24	10	14	8
69	156·2	55·2	29	84·2	23·2	11	12·2	8·8
68	154·4	54·4	28	82·4	22·4	12	10·4	9·6
67	152·6	53·6	27	80·6	21·6	13	8·6	10·4
66	150·8	52·8	26	78·8	20·8	14	6·8	11·2
65	149	52	25	77	20	15	5	12
64	147·2	51·2	24	75·2	19·2	16	3·2	12·8
63	145·4	50·4	23	73·4	18·4	17	1·4	13·6
62	143·6	49·6	22	71·6	17·6	18	0·4	14·4
61	141·8	48·8	21	69·8	16·8	19	2·2	15·2

THERMOMETER—*continued.*

CENT.	FAH'T.	RMR.	CENT.	FAH'T.	RMR.	CENT.	FAH'T.	RMR.
°	°	°	°	°	°	°	°	°
20	4	16	30	22	24	40	40	32
21	5·8	16·8	31	23·8	24·8	41	41·8	32·8
22	7·6	17·6	32	25·6	25·6	42	43·6	33·6
23	9·4	18·4	33	27·4	26·4	43	45·4	34·4
24	11·2	19·2	34	29·2	27·2	44	47·2	35·2
25	13	20	35	31	28	45	49	36
26	14·8	20·8	36	32·8	28·8	46	50·8	36·8
27	16·6	21·6	37	34·6	29·6	47	52·6	37·6
28	18·4	22·4	38	36·4	30·4	48	54·4	38·4
29	20·2	23·2	39	38·2	31·2	49	56·2	39·2

Synopsis of a Lecture Course on General Chemistry and Physics relating to Chemistry (to be fully illustrated with experiments).

Definition of matter and force. Conditions of matter and changes of state due to the influence of forces. Forces treated as, *a*, Physical ; *b*, Chemical.

a. Physical Forces, Gravitation, Cohesion, Adhesion, Elasticity.

Weights and balances. Specific gravities. The barometer, pumps, siphons.

Molecular attraction. Comparative hardness of bodies.

Capillary and surface attraction—Screw and hydraulic presses.

Physical condition of gases. Mariotte's law, air-pump, condensation of gases.

Solution, gaseous and liquid diffusion, dialysis, crystallization, crystallography, isomorphism, dimorphism, allotropy. Separation of soluble from insoluble matter.

Heat.—Its nature, development, and communication, radiation, absorption, conduction, and convection.

Effects of heat : Expansion—thermometers. Change of temperature—specific heat. Change of state—latent heat. Ebullition, vaporisation, distillation, influence on chemical action.

Light.—Its nature, influence on chemical changes. Polarized light, its nature and applications. The spectroscope, and its uses.

Electricity and Magnetism.—Brief sketch of principles and methods of developing. Electrolysis, telegraph, electric-lighting.

b. Chemical Force.

Chemical attraction as distinguished from gravitation. Chemical elements and their classification. Chemical symbols, with atomic or proportional numbers.

Non-Metallic Elements and their Combinations :—

Oxygen.—Ozone.

Hydrogen.—Water, peroxide of hydrogen, hydroxyl.

Nitrogen, its oxides, nitrous acid, nitric acid.—Ammonia, ammonium, amidogen, ammoniacal salts.

Carbon, its allotropic states.—Carbonic anhydride and acid. Carbonic oxide.

Chlorine, Bromine, and Iodine, their combinations with hydrogen, oxygen, and nitrogen.

Fluorine.—Hydrofluoric acid.

Sulphur and Selenium, their allotropic states, their combination with oxygen, hydrogen, chlorine, and carbon.

Phosphorus, its allotropic states, its conbination with non-metallic elements.

Silicon and Boron, and their compounds.

Laws of chemical combination, definite proportions, multiple proportions, atomic theory, Gay Lussac's law of volumes, quantivalence.

Determination of atomic and molecular weights.

Metallic Elements and their Compounds:—

Distinguishing characters of the metals, their classification, according to their quantivalence.

Acids, bases, and salts.

Potassium, sodium, lithium, cæsium, rubidium, and their compounds.

Silver and its compounds.

Barium, strontium, calcium, and their compounds.

Magnesium, zinc, cadmium, copper, mercury, lead, and their compounds.

Tin, aluminium, cerium, and their compounds.

Bismuth, antimony, arsenic, and their compounds.

Chromium, manganese, iron, nickel, cobalt, and their compounds.

Gold, platinum, palladium, rhodium, iridium, ruthenium, osmium.

Organic Chemistry.—Definition of organic compounds, action of oxygen, halogens, nitric acid, alkalis, hydrogen and dehydrating agents upon them, ultimate analysis, determination of formulæ, classification, organic radical, substitution, isomerism, metamerism, polymerism.

Cyanogen, ferrocyanogen, ferricyanogen, cyanic acid.

The chief hydrocarbons of the *fatty group,* their haloid, nitro-, and cyano-derivatives, amides, monatomic and polyatomic alcohols, oxygen ethers, ethereal salts, carbo-hydrates, aldehydes, ketones, acids, organo-metallic bodies.

The chief hydrocarbons of the *aromatic group,* their alcohols, aldehydes, and acids.

Terpenes, camphors.

Resins, balsams, glucosides, alkaloids, and other bodies of medicinal importance not included in the above.

Proximate constituents of animal bodies.

Synopsis of a Laboratory Course of Practical Analytical Chemistry.

Reactions and Separation of the Metals of the—

I.	II.	III.	IV.	V.
Silver Group.	*Copper Group.*	*Iron Group.*	*Barium Group.*	*Potassium Group.*
Silver.	Mercury.	Iron.	Barium.	Magnesium.
Mercury.	Lead.	Nickel.	Strontium.	Potassium.
Lead.	Bismuth.	Cobalt.	Calcium.	Sodium.
	Copper.	Zinc.		Ammonium.
	Cadmium.	Aluminium.		
	Arsenic.	Manganese.		
	Antimony.	Chromium.		
	Tin.			

Reactions and Separation of the Inorganic Acids.

I.	II.	III.	IV.
Sulphuric Acid Group.	*Phosphoric Acid Group.*	*Hydrochloric Acid Group.*	*Nitric Acid Group.*
Sulphuric Acid.	Phosphoric Acid.	Hydrochloric Acid.	Nitric Acid.
Hydrofluosilicic Acid.	Boric ,,	Hydrobromic ,,	Chloric ,,
	(Oxalic) ,,	Hydriodic ,,	Perchloric Acid.
	Hydrofluoric ,,	Hydrocyanic ,,	
	Carbonic ,,	Hypochlorous ,,	
	Silicic ,,	Nitrous ,,	
	Sulphurous ,,	Hydrosulphuric ,,	
	Hyposulphurous Acid		
	Arsenious ,,		
	Arsenic ,,		
	Iodic ,,		
	Chromic ,,		

Reactions and Separation of the Organic Acids.

I.	II.	III.
Tartaric Acid Group.	*Benzoic Acid Group.*	
Tartaric Acid.	Benzoic Acid.	Ferrocyanic Acid.
Citric ,,	Succinic ,,	Ferricyanic ,,
Malic ,,		Sulphocyanic ,,
		Acetic ,,
		Formic ,,

Tests for the following :—

Carbolic Acid.	Meconic Acid.	Starch.
Salicylic ,,	Strychnine.	Tannic Acid.
Ethylic Alcohol.	Brucine.	Gallic ,,
Amylic ,,	Quinine.	Detection of Carbon, Hydrogen, Nitrogen, Chlorine, and Sulphur in organic bodies.
Chloroform.	Cinchonine.	
Chloral.	Salicin.	
Glycerine.	Albumin.	
Morphine.	Grape-Sugar.	

Volumetric estimation of solution of ammonia, hydrochloric acid, hydrocyanic acid, arsenic, iron, iodine.

Type of Alternative Course (*Science and Art Department of the Committee of Council on Education*) :—

Sound, Light, and Heat (First Stage or Elementary Course).

Magnetism and Electricity (First Stage or Elementary Course).

Inorganic Chemistry.—*Theoretical* (First and Second Stages).
,, ,, *Practical* (,, ,,).
Organic ,, *Theoretical* (,, ,,).

(For details of the above see *Directory for Regulation of Science and Art Classes.* Chapman & Hall. London. Price 6d.)

Synopsis of a course of Lectures in Botany (including Botanical Laboratory Practice).

Objects and departments of botany. General distinctive characters between the members of the animal, vegetable, and mineral kingdoms.

Elementary structure of plants, or vegetable histology. Morphology and histology of the organs of nutrition in the Phanerogamia and the Cryptogamia, morphology and histology of the flower-stalk, inflorescence and of the parts of the flower in the Phanerogamia. Nature, general characters, and kinds of fruit.

Structure of ovule. Methods of fertilisation. General characters and structure of the seed. Germination, distinctive characters of Gymnosperms.

Reproductive organs of the Cryptogamia, as illustrated by a fern and a fungus.

Food of plants and its sources, function of absorption ; distribution of fluid matter, through the plant, and their alteration in the leaves and other green parts.

General principles of classification including meaning of the terms, species, variety, natural order, class, and kingdom. Systems of classification. Characters of the various divisions of the natural system classification in common use in this country.

Characters of the following British natural orders:—*Ranunculaceæ, Papaveraceæ, Cruciferæ, Caryophyllaceæ, Malvaceæ, Leguminosæ, Rosaceæ, Cucurbitaceæ, Onagraceæ, Umbelliferæ, Compositæ, Rubiaceæ, Gentianaceæ, Primulaceæ, Convolvulaceæ, Solanaceæ, Scrophulariaceæ, Labiatæ, Boraginaceæ, Polygonaceæ, Orchidaceæ, Iridaceæ, Liliaceæ, Melanthaceæ, Graminaceæ,* and *Filices.*

Type of Alternative Course (*Science and Art Department*) :—

Botany (First or Elementary Stage).
General Biology (First or Elementary Stage).

Popular Designations of Certain Pharmacopœial Preparations and Compounds.

Adhesive Plaster, . . .	Emp. Resinæ.
Anodyne Liniment, . .	Lin. Opii.
Aromatic Confection, . .	Pulv. Cretæ Aromaticus.
,, Powder, . . .	Pulv. Cinnam. Comp.
Basilicon Ointment, . .	Ung. Resinæ.

Black Draught, . . .	Mist. Sennæ Co.
Black Wash, ...	Lotio Hydrargyri Nigra.
Blue Pill, Ointment, . .	Pil., Ung. Hydrargyri.
Calomel, ...	Hydrargyri Subchloridum.
Carron-Oil, ...	Linim. Calcis.
Chemical Food, . . .	Syr. Ferri Phosp. Co. (non-pharml.)
Chloric Ether, . . .	Sp. Choroformi.
Chlorodyne, ...	Tr. Chlorof. et Morphinæ.
Citrine Ointment, . . .	Ung. Hydrargyri Nitratis.
Corrosive Sublimate, . .	Hydrargyri Perchloridum.
Cream of Tartar, . . .	Potassii Tartras Acida.
Diachylon, ...	Emplastrum Plumbi.
Donovan's Solution, . .	Liq. Arsen. Hydrarg. Iod.
Dover's Powder, . . .	Pulv. Ipecac. Co.
Easton's Syrup, . . .	Syr. Ferri et Quiniæ Strychniæ Phosph.
Elixir of Vitriol, . . .	Acid. Sulph. Aromat.
Epsom Salts, ...	Magnesii Sulphas.
Flowers of Sulphur, . .	Sulphur Sublimatum.
Fly-Blister, ...	Emplast. Cantharidis.
Fowler's Solution, . . .	Liq. Arsenicalis.
Friar's Balsam, . . .	Tr. Benzoini Co.
Glauber's Salts, . . .	Sodii Sulphas.
Goulard's Extract, . . .	Liq. Plumbi Subacetatis.
,, Lotion, . . . ,, Water, . . .	Liq. Plumbi Subacetatis Dil.
Granular Effervescent Citrate of Magnesia, . . .	Sodii Citro-Tartras Effervescens.
Gregory's Pills, . . .	Pil. Colocynth. Co.
Gregory's Powder, . . .	Pulv. Rhei Co.
Grey Powder, ...	Hydrargyrum cum Cretâ.
Griffith's Mixture, . . .	Mist. Ferri Co.
Hamilton's Pills, . . .	Pil. Colocynth. et Hyos.
Hartshorn, ...	Liq. Ammoniæ.
Heberden's Ink, . . .	Mist. Ferri Aromat.
Huxham's Tincture, . .	Tinct. Cinch. Co.
Laudanum, ...	Tr. Opii.
Lenitive Electuary, . .	Confect. Sennæ.
Litharge, ...	Plumbi Oxidum.
Liver of Sulphur, . . .	Potassa Sulphurata.
Lunar Caustic, . . .	Argenti Nitras.
Milk of Sulphur, . . .	Sulphur Præcipitatum (P.L.).
Mindererus Spirit, . . .	Liq. Ammoniæ Acetatis.
Nitre, Saltpetre, . . .	Potassii Nitras.
Oil of Male Fern, . . .	Extract. Filicis Liquidum.
Oil of Vitriol, . . .	Acidum Sulphuricum.
Opodeldoc, ...	Lin. Saponis.
Paregoric Elixir, . . .	Tr. Camphoræ Co.
Plummer's Pill, . . .	Pil. Hydrarg. Subchloridi Co.
Prussic Acid, . . .	Ac. Hydrocyanicum Dil.
Red Precipitate, . . .	Hydrarg. Ox. Rubr.
Rochelle Salts, . . .	Soda Tartarata.
Sal Ammoniac, . . .	Ammonii Chloridum.
Salt of Tartar, . . .	Potassii Carbonas.
Sal Volatile, ...	Sp. Ammoniæ Aromaticus.
Scotch Paregoric, . . .	Tr. Opii Ammoniata.

Scott's Ointment, . . .	Ung. Hydrargyri Co.
Solution of Bismuth, . .	Liq. Bismuth et Amm. Cit.
Steel Drops, ...	Tinct. Ferri Perchlor.
Sugar of Lead, . . .	Plumbi Acetas.
Sweet Spirits of Nitre, . .	Sp. Ætheris Nitrosi.
Tartar Emetic, . . .	Antimonium Tartaratum.
Tutty Powder, . . .	Zinci Oxidum.
Vitriol : Blue, Green, White, .	Cupri, Ferri, Zinci Sulphas.
White Arsenic . . .	Acidum Arseniosum.
White Precipitate, . . .	Hydrargyrum Ammoniatum.
Yellow Wash, . . .	Lotio Hydrargyri Flava.

Precautions Required by the Pharmacy Act, 1868, to be observed in Selling by Retail and in Dispensing Poison.

All the articles named or referred to in the list on page 264, both in Part 1 and Part 2, are Poisons within the meaning of the Pharmacy Act, 1868.

Sale by Retail.

1. *Relating to Part* 1 *and Part* 2 *of the list.*

It is unlawful to sell any "Poison" by retail, unless the vessel, wrapper, or cover in which it is contained be distinctly labelled with the *name of the article*, the word "**Poison**," and the *name and address of the seller. This applies to all the articles in both parts of the list.*

2. *Relating to Part* 1 *only.*

It is unlawful to sell by retail any poison included in Part 1 of the list to any person unknown to the seller, unless introduced by some person known to the seller, and on every sale of any such article the seller shall, before delivery, make or cause to be made an entry in a book to be kept for that purpose of—

(1) The date of sale; (2) the name and address of the purchaser; (3) the name and quantity of the article sold; and (4) the purpose for which it is stated to be required; to which the signature of the purchaser, and of the person, if any, who introduced him, shall be affixed. *The article must also be labelled with the name of the article, the word* "**Poison**," *and the name and address of the seller.*

3. *Relating only to Arsenic and its Preparations.*

It is unlawful to sell Arsenic, or any of its preparations, unless in addition to all the foregoing regulations, the following provisions of the Arsenic Act be also observed :—

1. That the poison, if colourless, be mixed with soot or indigo, so as to colour it.

2. That the person to whom the poison is sold or delivered be of mature age.

3. That the occupation, as well as the name and address of the purchaser, be entered in the poison-book.

4. That when the purchaser is not known to the seller, and is introduced by some person known to both, this person shall be present as a witness to the transaction, and shall enter his name and address in the poison-book.

Dispensing.

None of the foregoing regulations apply to any article when forming part of the ingredients of any medicine dispensed by a Registered Chemist and Druggist, but it is necessary if a medicine contain a poison included in Part 1 or Part 2 of the list, that the ingredients of the medicine, together with the name of the person to whom it is sold or delivered be entered in a book kept for that purpose (Prescription-Book), and that the name and address of the seller be attached to the medicine.

N.B.—*For List of Poisons within the meaning of the Act, see next page.*

List of Poisons within the meaning of the Act.

PART I.		PART II.	
Not to be sold unless the purchaser is known to, or is introduced by, some person known to the seller; also entry to be made in Poison Book; 1. Date of Sale; 2. Name and Address of Purchaser; 3. Name and quantity of article; 4. Purpose for which it is wanted; Attested by Signature; and must be labelled with 1. Name of Article; 2. The word "Poison"; 3. Name and Address of Seller.	Arsenic, and its preparations; Aconite, and its preparations; Alkaloids: — All poisonous vegetables alkaloids, and their salts; Atropine, and its preparations; Cantharides; Corrosive Sublimate; Cyanide of Potassium, and all metallic cyanides and their preparations; Emetic tartar; Ergot of rye, and its preparations; Prussic acid, and its preparations; Savin, and its oil; Strychnine, and its preparations; Vermin-killers, if preparations of poisons the preparations of which are in Part I. of this Schedule.	Must be labelled with 1. Name of Article; 2. The word "Poison"; 3. Name and Address of Seller.	Almonds, essential oil (*unless deprived of Prussic acid*); Belladonna, and its preparations; Cantharides, tincture, and all vesicating liquid preparations of; Chloroform; Chloral hydrate, and its preparations; Corrosive sublimate, preparations of; Morphia, preparations of; Nux vomica, and its preparations; Opium, and its preparations; and preparations of poppies; Oxalic acid; Precipitate, red (red oxide of mercury); Precipitate, white (ammoniated mercury); Vermin-killers (see Part I.) Compounds containing "poisons" prepared for the destruction of Vermin, if not subject to the provisions of Part I., are in Part II.

INDEX.

PRINTED BY NEILL AND COMPANY, EDINBURGH.

A

CATALOGUE

OF

STANDARD WORKS

PUBLISHED BY

CHARLES GRIFFIN & COMPANY.

LONDON:

12 EXETER STREET, STRAND.

INDEX.

CHARLES GRIFFIN & COMPANY'S
LIST OF PUBLICATIONS.

RELIGIOUS WORKS.

ANECDOTES (CYCLOPÆDIA OF RELIGIOUS AND MORAL). With an Introductory Essay by the Rev. GEORGE CHEEVER, D.D. *Thirty-sixth Thousand.* Crown 8vo. Cloth, 3/6.

*** These Anecdotes relate to no trifling subjects; and they have been selected, not for amusement, but for instruction. By those engaged in the tuition of the young, they will be found highly useful.

BIBLE HISTORY (A Manual of). By the Rev. J. WYCLIFFE GEDGE, Diocesan Inspector of Schools for Winchester. Small 8vo. Cloth, neat, 7d.

"This small but very comprehensive Manual is much more than a mere summary of Bible History."—*Church Sunday School Magazine.*

THE LARGE-TYPE BUNYAN.

BUNYAN'S PILGRIM'S PROGRESS. With Life and Notes, Experimental and Practical, by WILLIAM MASON. Printed in large type, and Illustrated with full-page Woodcuts. *Twelfth Thousand.* Crown 8vo. Bevelled boards, gilt, and gilt edges, 3/6.

CHRISTIAN YEAR (The): With Memoir of the Rev. JOHN KEBLE, by W. TEMPLE, Portrait, and Eight Engravings on Steel, after eminent Masters. *New Edition.* Small 8vo, toned paper. Cloth gilt, 5/.

Morocco elegant, ... 10/6.
Malachite, ... 12/6.

*** The above is the only issue of the "Christian Year" with Memoir and Portrait of the Author. In ordering, Griffin's Edition should be specified.

CRUTTWELL (REV. C. T., M.A.) A HISTORY OF EARLY CHRISTIAN LITERATURE. In large 8vo, handsome cloth. [*In preparation.*

*** This work is intended not only for Theological Students, but for General Readers, and will be welcomed by all acquainted with the Author's admirable "*History of Roman Literature,*" a work which has now reached its Fourth Edition.

DICK (Thos., LL.D.): CELESTIAL SCENERY; or, The Wonders of the Planetary System Displayed. This Work is intended for general readers, presenting to their view, in an attractive manner, sublime objects of contemplation. Illustrated. *New Edition.* Crown 8vo, toned paper. Handsomely bound, gilt edges, 5/.

DICK (Dr.): CHRISTIAN PHILOSOPHER (The); or, The Connection of Science and Philosophy with Religion. Revised and enlarged. Illustrated with 150 Engravings on Wood. *Twenty-eighth Edition.* Crown 8vo, toned paper. Handsomely bound, with gilt edges, 5/.

FOSTER (C.): THE STORY OF THE BIBLE, from Genesis to Revelation—including the Historical Connection between the Old and New Testaments. Told in Simple Language.

Now Ready. FOURTH AND GREATLY IMPROVED EDITION. In ROYAL 8VO. Cloth Elegant, 6s. Gilt and Gilt Edges, 7/6.

With Maps and over 250 Engravings

(Many of them Full-page, after the Drawings of Professor CARL SCHÖNHERR and others),

Illustrative of the Bible Narrative, and of Eastern Manners and Customs.

OPINIONS OF THE PRESS.

"A book which, once taken up, is not easily laid down. When the volume is opened, we are fairly caught. Not to speak of the well-executed wood engravings, which will each tell its story, we find a simple version of the main portions of the Bible, all that may most profitably be included in a work intended at once to instruct and charm the young—a version couched in the simplest, purest, most idiomatic English, and executed throughout with good taste, and in the most reverential spirit. *The work needs only to be known to make its way into families,* and it will (at any rate, it *ought* to) become a favourite Manual in Sunday Schools."—*Scotsman.*

"A HOUSEHOLD TREASURE."—*Western Morning News.*

"This attractive and handsome volume . . . written in a simple and transparent style. . . . Mr. Foster's explanations and comments are MODELS OF TEACHING."—*Freeman.*

"This large and handsome volume, abounding in Illustrations, is just what is wanted. . . . The STORY is very beautifully and reverently told."—*Glasgow News.*

"There could be few better Presentation Books than this handsome volume."—*Daily Review.*

"WILL ACCOMPLISH A GOOD WORK."—*Sunday School Chronicle.*

"In this beautiful volume no more of comment is indulged in than is necessary to the elucidation of the text. Everything approaching Sectarian narrowness is carefully eschewed."—*Methodist Magazine.*

"This simple and impressive Narrative . . . succeeds thoroughly in riveting the attention of children; . . . admirably adapted for reading in the Home Circle."—*Daily Chronicle.*

"The HISTORICAL SKETCH connecting the Old and New Testaments is a very good idea; it is a common fault to look on these as distinct histories, instead of as parts of *one grand whole.*"—*Christian.*

"Sunday School Teachers and Heads of Families will best know how to value this handsome volume."—*Northern Whig.*

*** The above is the original English Edition. In ordering, Griffin's Edition, by Charles Foster, should be distinctly specified.

STANDARD BIBLICAL WORKS

BY

THE REV. JOHN EADIE, D.D., LL.D.,

Late a Member of the New Testament Revision Company.

This SERIES has been prepared to afford sound and necessary aid to the Reader of Holy Scripture. The VOLUMES comprised in it form in themselves a COMPLETE LIBRARY OF REFERENCE. The number of Copies already issued greatly exceeds A QUARTER OF A MILLION.

I. EADIE (Rev. Prof.): BIBLICAL CYCLOPÆDIA (A);

or, Dictionary of Eastern Antiquities, Geography, and Natural History, illustrative of the Old and New Testaments. With Maps, many Engravings, and Lithographed Fac-simile of the Moabite Stone. Large post 8vo, 700 pages. *Twenty-fifth Edition.*

Handsome cloth, ... 7/6.
Morocco antique, gilt edges, . . 16/.

"By far the best Bible Dictionary for general use."—*Clerical Journal.*

II. EADIE (Rev. Prof.): CRUDEN'S CONCORDANCE TO THE HOLY SCRIPTURES.

With Portrait on Steel, and Introduction by the Rev. Dr. KING. Post 8vo. *Fifty-first Edition.* Handsome cloth, ... 3/6.

*** Dr. EADIE'S has long and deservedly borne the reputation of being the COMPLETEST and BEST CONCORDANCE extant.

III. EADIE (Rev. Prof.): CLASSIFIED BIBLE (The).

An Analytical Concordance. Illustrated by Maps. Large Post 8vo. *Sixth Edition.* Handsome cloth, ... 8/6.

"We have only to add our unqualified commendation of a work of real excellence to every Biblical student."—*Christian Times.*

IV. EADIE (Rev. Prof.): ECCLESIASTICAL CYCLOPÆDIA (The).

A Dictionary of Christian Antiquities, and of the History of the Christian Church. By the Rev. Professor EADIE, assisted by numerous Contributors. Large Post 8vo. *Sixth Edition.*

Handsome cloth, ... 8/6.

"The ECCLESIASTICAL CYCLOPÆDIA will prove acceptable both to the clergy and laity of Great Britain. A great body of useful information will be found in it."—*Athenæum.*

V. EADIE (Rev. Prof.): DICTIONARY OF THE HOLY BIBLE (A);

for the use of Young People. With Map and Illustrations. Small 8vo. *Thirty-eighth Thousand.*

Cloth, elegant, ... 2/6.

RELIGIONS OF THE WORLD (The): Being Confessions of Faith contributed by Eminent Members of every Denomination of Christians, also of Mahometanism, Parseeism, Brahminism, Mormonism, &c., &c., with a Harmony of the Christian Confessions of Faith by a Member of the Evangelical Alliance. Crown 8vo. Cloth bevelled, 3/6.

SOUTHGATE (Henry): SUGGESTIVE THOUGHTS ON RELIGIOUS SUBJECTS. (See page 36.)

SOUTHGATE (Mrs. H.): THE CHRISTIAN LIFE: Thoughts in Prose and Verse from Five hundred of the Best Writers of all Ages. Selected and Arranged for Every Day in the Year. Small 8vo. With Red Lines and unique Initial Letters on each page. Cloth Elegant, 5/. Morocco, 10/6. *Second Edition.*

"A volume as handsome as it is intrinsically valuable."—*Scotsman.*
"The readings are excellent."—*Record.*
"A library in itself."—*Northern Whig.*

TAIT (Rev. James): MIND IN MATTER: A Short Argument on Theism. *Second Edition.* Demy 8vo. Handsome Cloth, 8/6.

General Contents.—Evolution in Nature and Mind—Mr. Darwin and Mr. Herbert Spencer—Inspiration, Natural and Supernatural—Deductions.

"An able and original contribution to Theistic literature. . . . The style is pointed, concise, and telling to a degree."—*Glasgow Herald.*
"Mr. Tait advances many new and striking arguments . . . highly suggestive and fresh."—*Brit. Quarterly Review.*

THE MASSES: How Shall we Reach Them? Some Hindrances in the way, set forth from the standpoint of the People, with Comments and Suggestions. By an Old Lay-helper. Cloth, 2s. 6d. *Second Edition.*

*** An attempt to set forth some deficiencies in our present methods of reaching the poor, in the language of the people themselves.

"So full of suggestiveness that we should reprint a tithe of the book if we were to transcribe all the extracts we should like to make."—*Church Bells.*

"'Hindrances in the way' exactly describes the subject-matter of the Book. Any one contemplating Missionary work in a large town would be helped by studying it."—*Guardian.*

"'The Masses' is a book to be well pondered over and acted upon."—*Church Work.*

"A very useful book, well worth reading."—*Church Times.*

"A most interesting book. . . . Contains a graphic description of work among the masses."—*English Churchman.*

WORDS AND WORKS OF OUR BLESSED LORD: and their Lessons for Daily Life. Two Vols. in One. Foolscap 8vo. Cloth, gilt edges, 6/.

WORKS

By Sir WILLIAM AITKEN, M.D., Edin., F.R.S.,

PROFESSOR OF PATHOLOGY IN THE ARMY MEDICAL SCHOOL; EXAMINER IN MEDICINE FOR THE MILITARY MEDICAL SERVICES OF THE QUEEN; FELLOW OF THE SANITARY INSTITUTE OF GREAT BRITAIN; CORRESPONDING MEMBER OF THE ROYAL IMPERIAL SOCIETY OF PHYSICIANS OF VIENNA; AND OF THE SOCIETY OF MEDICINE AND NATURAL HISTORY OF DRESDEN.

Seventh Edition.

The SCIENCE and PRACTICE of MEDICINE.

In Two Volumes, Royal 8vo., cloth. Illustrated by numerous Engravings on Wood, and a Map of the Geographical Distribution of Diseases. To a great extent Rewritten; Enlarged, Remodelled, and Carefully Revised throughout, 42/.

Opinions of the Press.

"The work is an admirable one, and adapted to the requirements of the Student, Professor, and Practitioner of Medicine. . . . The reader will find a large amount of information not to be met with in other books, epitomised for him in this. We know of no work that contains so much, or such full and varied information on all subjects connected with the Science and Practice of Medicine."—*Lancet.*

"Excellent from the beginning, and improved in each successive issue, Dr. Aitken's GREAT and STANDARD WORK has now, with vast and judicious labour, been brought abreast of every recent advance in scientific medicine and the healing art, and affords to the Student and Practitioner a store of knowledge and guidance of altogether inestimable value. . . . A classical work which does honour to British Medicine, and is a compendium of sound knowledge."—*Extract from Review in "Brian," by J. Crichton-Browne, M.D., F.R.*

"The Seventh Edition of this important Text-Book fully maintains its reputation. . . . Dr. Aitken is indefatigable in his efforts. . . . The section on Diseases of the Brain and Nervous System is completely remodelled, so as to include all the most recent researches, which in this department have been not less important than they are numerous"—*British Medical Journal.*

"The Standard Text-Book in the English Language. . . . There is, perhaps, no work more indispensable for the Practitioner and Student."—*Edin. Medical Journal.*

"The extraordinary merit of Dr. Aitken's work. . . . The author has unquestionably performed a service to the profession of the most valuable kind."—*Practitioner.*

OUTLINES OF THE SCIENCE AND

PRACTICE OF MEDICINE. A Text-Book for Students. *Second Edition.* Crown 8vo, 12/6.

"Students preparing for examinations will hail it as a perfect godsend for its conciseness."—*Athenæum.*

"Well-digested, clear, and well-written, the work of a man conversant with every detail of his subject, and a thorough master of the art of teaching."—*British Medical Journal.*

CAIRD (F. M., M.B., F.R.C.S.), and CATHCART (C. W., M.B., F.R.C.S.):

A SURGICAL HANDBOOK: For the use of Practitioners, Students, House-Surgeons, and Dressers. With Numerous Illustrations. *Third Edition.* Pocket-size, Leather, 8/6.

"This is a THOROUGHLY PRACTICAL MANUAL, well up to date, clear, accurate, and succinct. It is thoroughly trustworthy, handy, and well got up."—*Lancet.*

WORKS by A. WYNTER BLYTH, M.R.C.S., F.C.S.,
Public Analyst for the County of Devon, and Medical Officer of Health for St. Marylebone.

I. FOODS: THEIR COMPOSITION AND ANALYSIS.

Price 16/. In Crown 8vo, cloth, with Elaborate Tables and Litho-Plates. *Third Edition.* Revised and partly rewritten.

General Contents.

History of Adulteration—Legislation, Past and Present—Apparatus useful to the Food Analyst—"Ash"—Sugar—Confectionery—Honey—Treacle—Jams and Preserved Fruits—Starches—Wheaten-Flour—Bread—Oats—Barley—Rye—Rice—Maize—Millet—Potato—Peas—Chinese Peas—Lentils—Beans—MILK—Cream—Butter—Cheese—Tea—Coffee—Cocoa and Chocolate—Alcohol—Brandy—Rum—Whisky—Gin—Arrack—Liqueurs—Beer—Wine—Vinegar—Lemon and Lime Juice—Mustard—Pepper—Sweet and Bitter Almond—Annatto—Olive Oil—Water. *Appendix:* Text of English and American Adulteration Acts.

"Will be used by every Analyst."—*Lancet.*

"STANDS UNRIVALLED for completeness of information. . . . A really 'practical' work for the guidance of practical men."—*Sanitary Record.*

"An admirable digest of the most recent state of knowledge. . . . Interesting even to lay-readers."—*Chemical News.*

*** The NEW EDITION contains many Notable Additions, especially on the subject of MILK and its relation to FEVER-EPIDEMICS, the PURITY of WATER-SUPPLY, the new MARGARINE ACT, &c., &c.

COMPANION VOLUME.

II. POISONS: THEIR EFFECTS AND DETECTION.

Price 16/. *Second Edition.*

General Contents.

Historical Introduction—Statistics—General Methods of Procedure—Life Tests—Special Apparatus—Classification: I.—ORGANIC POISONS: (*a.*) Sulphuric, Hydrochloric, and Nitric Acids, Potash, Soda, Ammonia, &c.; (*b.*) Petroleum, Benzene, Camphor, Alcohols, Chloroform, Carbolic Acid, Prussic Acid, Phosphorus, &c.; (*c.*) Hemlock, Nicotine, Opium, Strychnine, Aconite, Atropine, Digitalis, &c.; (*d.*) Poisons derived from Animal Substances; (*e.*) The Oxalic Acid Group. II.—INORGANIC POISONS: Arsenic, Antimony, Lead, Copper, Bismuth, Silver, Mercury, Zinc, Nickel Iron, Chromium, Alkaline Earths, &c. *Appendix:* A. Examination of Blood and Blood-Spots. B. *Hints for Emergencies:* Treatment—Antidotes.

"Should be in the hands of every medical practitioner."—*Lancet.*

"A sound and practical Manual of Toxicology, which cannot be too warmly recommended. One of its chief merits is that it discusses substances which have been overlooked."—*Chemical News.*

"One of the best, most thorough, and comprehensive works on the subject."—*Saturday Review.*

HYGIÈNE AND PUBLIC HEALTH (a Dictionary of):

embracing the following subjects:—

I.—SANITARY CHEMISTRY: the Composition and Dietetic Value of Foods, with the Detection of Adulterations.

II.—SANITARY ENGINEERING: Sewage, Drainage, Storage of Water, Ventilation, Warming, &c.

III.—SANITARY LEGISLATION: the whole of the PUBLIC HEALTH ACT, together with portions of other Sanitary Statutes, in a form admitting of easy and rapid Reference.

IV.—EPIDEMIC AND EPIZOOTIC DISEASES: their History and Propagation, with the Measures for Disinfection.

V.—HYGIÈNE—MILITARY, NAVAL, PRIVATE, PUBLIC, SCHOOL.

Royal 8vo, 672 pp., cloth, with Map and 140 Illustrations, 28/.

"A work that must have entailed a vast amount of labour and research. . . . Will become a STANDARD WORK IN PUBLIC HEALTH."—*Medical Times and Gazette.*

"Contains a great mass of information of easy reference."—*Sanitary Record.*

DAVIS (J. R. A., B.A., Lecturer on Biology at the University College of Wales, Aberystwyth):

AN INTRODUCTION TO BIOLOGY, for the use of Students. Comprising Vegetable and Animal Morphology and Physiology.

With Bibliography, Exam.-Questions, complete Glossary, and 158 *Illustrations. Large Crown* 8*vo.* 12*s.* 6*d.*

"The volume is literally packed with information."—*Glasgow Medical Journal.*

"As a general work of reference, Mr. Davis' Manual will be highly serviceable both to medical men and to amateur or professional scientists."—*British Medical Journal.*

THE FLOWERING-PLANT: First Principles of Botany. Specially adapted to the Requirements of Students preparing for Competitive Examinations. With numerous Illustrations. Crown 8vo, Cloth, 3s. 6d.

DUCKWORTH (Sir Dyce, M.D. (Edin.), F.R.C.P.):

GOUT (A Treatise on): for the Use of Practitioners and Students. With Chromo-Lithograph, Folding Plate, and Illustrations. Royal 8vo, 25s.

"At once thoroughly practical and highly philosophical. The practitioner will find an enormous amount of information in it."—*Practitioner.*

DUPRÉ (A., Ph.D., F.R.S.), and WILSON HAKE (Ph.D., F.I.C., F.C.S., of the Westminster Hospital Medical School):

INORGANIC CHEMISTRY (A Short Manual of): with Coloured Plate of Spectra. Crown 8vo, Cloth, 7s. 6d.

"The BEST MANUAL for Medical aspirants that has appeared on the subject of Inorganic Chemistry."—*Analyst.*

"A well-written, clear, and accurate Elementary Manual of Inorganic Chemistry. . . . We agree heartily in the system adopted by Drs. Dupré and Hake. WILL MAKE EXPERIMENTAL WORK TREBLY INTERESTING BECAUSE INTELLIGIBLE."—*Saturday Review.*

ELBORNE (W., F.L.S., F.C.S., late Assistant-Lecturer in Materia Medica and Pharmacy, Owens College, Manchester):

PHARMACY AND MATERIA MEDICA (A Laboratory Course of): Including the Principles and Practice of Dispensing. Adapted to the Study of the British Pharmacopœia and the requirements of the Private Student. With Litho-Plates, and numerous Illustrations. Large crown 8vo. Cloth, 8s. 6d.

EWART (J. COSSAR, M.D., F.R.S.E., Regius Professor of Natural History, University of Edinburgh):

THE PRESERVATION OF FISH, in reference to Food Supply Hints on). In Crown 8vo, Wrapper, 6d.

GARROD (A.E., M.A., M.D., Oxon., M.R.C.P., Assistant-Physician to the West London Hospital, &c.):

RHEUMATISM AND RHEUMATOID ARTHRITIS (A Treatise on): for the Use of Students and Practitioners. With Charts and Illustrations. Medium 8vo. Cloth, 21s.

GRIFFIN (John Joseph, F.C.S.):

CHEMICAL RECREATIONS: A Popular Manual of Experimental Chemistry. With 540 Engravings of Apparatus. *Tenth Edition.* Crown 4to. Cloth.

Part I.—Elementary Chemistry, 2/.

Part II.—The Chemistry of the Non-Metallic Elements, including a Comprehensive Course of Class Experiments, 10/6.

Or, complete in one volume, cloth, gilt top, . . 12/6.

HADDON (A. C., M.A., F.Z.S., Professor of Zoology at the Royal College of Science, Dublin):

AN INTRODUCTION TO THE STUDY OF EMBRYOLOGY, for the use of Students. With 190 Illustrations. In Royal 8vo, Cloth, 18s.

"An EXCELLENT RÉSUMÉ OF RECENT RESEARCH, well adapted for self-study. . . . Gives remarkably good accounts (including all recent work) of the development of the heart and other organs. . . . The book is handsomely got up."—*Lancet.*

"PROF. HADDON has the real scientific spirit for work of this kind. . . . The development of the various organs ably demonstrated. . . . Forms a handsome volume."—*Brit. Med. Journal.*

HUMPHRY (L., M.A., M.B., M.R.C.S., Assistant-Physician to, and Lecturer to Probationers at, Addenbrooke's Hospital, Cambridge):

NURSING (A Manual of): Medical and Surgical. With Numerous Illustrations. *Second Edition.* Crown 8vo, Cloth, 3s. 6d.

"We would advise all Nurses to possess a copy."—*The Hospital.*

JAKSCH (Prof. R. von, University of Graz):

CLINICAL DIAGNOSIS: A Text-book of the Chemical, Microscopical, and Bacteriological Evidence of Disease. Translated from the Second German Edition, by JAMES CAGNEY, M.A., M.D., St. Mary's Hospital. With additions by WM. STIRLING, M.D., Sc.D., Prof. of Physiology, Owens College, Manchester. With numerous Illustrations in Colour. Medium 8vo, 25s.

LANDIS (Henry G., A.M., M.D., Professor of Obstetrics in Starling Medical College):

THE MANAGEMENT OF LABOUR AND OF THE LYING-IN PERIOD. In 8vo, with Illustrations. Cloth, 7/6.

"Fully accomplishes the object kept in view by its author. . . . Will be found of GREAT VALUE by the young practitioner."—*Glasgow Medical Journal.*

LEWIS (W. Bevan, L.R.C.P., M.R.C.S., Medical Director of the West-Riding Asylum, Wakefield):

MENTAL DISEASES (A Text-book of): With Special Reference to the Pathological Aspects of Insanity. For the Use of Students and Practitioners. With 18 Litho-Plates, Charts, and Illustrations. Royal 8vo, 28/.

"A splendid addition to the literature of mental diseases. . . . Every page bristles with important facts. As a standard work on the pathology of mental diseases the volume should occupy a prominent place."—*Dublin Medical Journal.*

By Professors LANDOIS and STIRLING.

HUMAN PHYSIOLOGY

(A TEXT-BOOK OF):

Including Histology and Microscopical Anatomy.

WITH SPECIAL REFERENCE TO PRACTICAL MEDICINE,

By DR. L. LANDOIS,

PROF. OF PHYSIOLOGY, UNIVERSITY OF GREIFSWALD.

Translated from the Sixth German Edition, with Annotations and Additions,

By WM. STIRLING, M.D., Sc.D.,

BRACKENBURY PROFESSOR OF PHYSIOLOGY IN OWENS COLLEGE, AND VICTORIA UNIVERSITY, MANCHESTER; EXAMINER IN THE UNIVERSITIES OF OXFORD AND CAMBRIDGE.

Royal 8vo, Handsome Cloth. 34s.

With very Numerous Illustrations.

THIRD ENGLISH EDITION.

GENERAL CONTENTS.

PART I.—Physiology of the Blood, Circulation, Respiration, Digestion, Absorption, Animal Heat, Metabolic Phenomena of the Body.

PART II.—Secretion of Urine; Structure of the Skin; Physiology of the Motor Apparatus; the Voice and Speech; General Physiology of the Nerves; Electro-Physiology; the Brain; Organs of Vision, Hearing, Smell, Taste, Touch; Physiology of Development.

*** Since its first appearance in 1880, Prof. LANDOIS' TEXT-BOOK OF PHYSIOLOGY has been translated into three Foreign languages, and passed through five large editions.

To meet the wishes of Students, the THIRD ENGLISH EDITION has been issued in ONE VOLUME, printed on specially prepared paper. Numerous Additions have been made throughout, bringing the work abreast in all respects of the latest researches in Physiology and their bearing on Practical Medicine; and the number of Illustrations has also been largely increased—from 494 in the First to 692 in the present Edition.

"So great are the advantages offered by Prof. LANDOIS' TEXT-BOOK, from the EXHAUSTIVE and EMINENTLY PRACTICAL manner in which the subject is treated, that it has passed through FOUR large editions in the same number of years. . . . Dr. STIRLING'S annotations have materially added to the value of the work. Admirably adapted for the PRACTITIONER. . . . With this Text-book at command, NO STUDENT COULD FAIL IN HIS EXAMINATION."—*The Lancet.*

"One of the MOST PRACTICAL WORKS on Physiology ever written, forming a 'bridge' between Physiology and Practical Medicine. . . . Its chief merits are its completeness and conciseness. . . . The additions by the Editor are able and judicious. . . . EXCELLENTLY CLEAR, ATTRACTIVE, AND SUCCINCT."—*Brit. Med. Journal.*

"The great subjects dealt with are treated in an admirably clear, terse, and happily-illustrated manner. At every turn the doctrines laid down are illuminated by reference to facts of Clinical Medicine or Pathology."—*Practitioner.*

"We have no hesitation in saying that THIS IS THE WORK to which the PRACTITIONER will turn whenever he desires light thrown upon, or information as to how he can best investigate, the phenomena of a COMPLICATED OR IMPORTANT CASE. To the STUDENT it will be EQUALLY VALUABLE."—*Edinburgh Medical Journal.*

"LANDOIS and STIRLING'S work cannot fail to establish itself as one of the most useful and popular works known to English readers."—*Manchester Medical Chronicle.*

"As a work of reference, LANDOIS and STIRLING'S Treatise OUGHT TO TAKE THE FOREMOST PLACE among the text-books in the English language. The woodcuts are noticeable for their number and beauty."—*Glasgow Medical Journal.*

"Unquestionably the most admirable exposition of the relations of Human Physiology to Practical Medicine that has ever been laid before English readers."—*Students' Journal.*

By Drs. MEYER and FERGUS.

Now Ready, with Three Coloured Plates and numerous Illustrations.
Royal 8vo, Handsome Cloth, 25s.

DISEASES OF THE EYE

(A PRACTICAL TREATISE ON),

BY EDOUARD MEYER,

Prof. à l'Ecole Pratique de la Faculté de Médecine de Paris,
Chev. of the Leg. of Honour, &c.

Translated from the Third French Edition, with Additions as contained in the Fourth German Edition,

By F. FERGUS, M.B., Ophthalmic Surgeon, Glasgow Infirmary.

The particular features that will most commend Dr. Meyer's work to English readers are—its CONCISENESS, its HELPFULNESS in explanation, and the PRACTICALITY of its directions. The best proof of its worth may, perhaps, be seen in the fact that it has now gone through *three* French and *four* German editions, and has been translated into most European languages—Italian, Spanish, Russian, and Polish—and even into Japanese.

Opinions of the Press.

"A GOOD TRANSLATION OF A GOOD BOOK. . . . A SOUND GUIDE in the diagnosis and treatment of the various diseases of the eye that are likely to fall under the notice of the general Practitioner. The Paper, Type, and Chromo-Lithographs are all that could be desired. . . . We know of no work in which the DISEASES and DEFORMITIES of the LIDS are more fully treated. Numerous figures illustrate almost every defect remediable by operation."—*Practitioner.*

"A VERY TRUSTWORTHY GUIDE in all respects. . . . THOROUGHLY PRACTICAL. Excellently translated, and very well got up. Type, Woodcuts, and Chromo-Lithographs are alike excellent."—*Lancet.*

"Any Student will find this work of GREAT VALUE. . . . The chapter on Cataract is excellent. . . . The Illustrations describing the various plastic operations are specially helpful."—*Brit. Med. Journal.*

"An EXCELLENT TRANSLATION of a standard French Text-Book. . . . We can cordially recommend Dr. Meyer's work. It is essentially a PRACTICAL WORK. The Publishers have done their part in the tasteful and substantial manner characteristic of their medical publications."—*Ophthalmic Review.*

LINN (S.H., M.D., D.D.S., Dentist to the Imperial Medico-Chirurgical Academy of St. Petersburg):

THE TEETH: How to preserve them and prevent their Decay. A Popular Treatise on the Diseases and the Care of the Teeth. With Plates and Diagrams. Crown 8vo. Cloth, 2/6.

LONGMORE (Surgeon-General, C.B., Q.H.S., F.R.C.S., &c., Professor of Military Surgery, Army Medical School):

THE SANITARY CONTRASTS OF THE CRIMEAN WAR. Demy 8vo. Cloth limp, 1/6.

"A most valuable contribution to Military Medicine."—*British Medical Journal.*
"A most concise and interesting Review."—*Lancet.*

MACALISTER (A., M.D., F.R.S., Professor of Anatomy, University of Cambridge):

HUMAN ANATOMY: Systematic and Topographical (A Text-book of), including the Embryology, Histology, and Morphology of Man, with Special Reference to the Requirements of Practical Surgery and Medicine. With 816 Illustrations. Medium 8vo. 36s.

"By far the most important work on this subject which has appeared in recent years. . . . Not only deals with Descriptive and Topographical Anatomy, but is also a complete treatise on Human Embryology, Histology, and Morphology."—*The Lancet.*

OBERSTEINER (Prof. H., University of Vienna):

THE CENTRAL NERVOUS ORGANS. A Guide to the Study of their Structure in Health and Disease. Translated, with annotations and additions, by ALEX. HILL, M.A., M.D., Master of Downing College, Cambridge. With all the Original Illustrations. Medium 8vo, 25s.

PARKER (Prof. W. Kitchen, F.R.S., Hunterian Professor, Royal College of Surgeons):

MAMMALIAN DESCENT: being the Hunterian Lectures for 1884. Adapted for General Readers. With Illustrations. In 8vo, cloth, 10/6.

"A very striking book . . . as readable as a book of travels. Prof. PARKER is no Materialist."—*Leicester Post.*

PORTER (Surgeon-Major J. H., Late Assistant Professor of Military Surgery in the Army Medical School):

THE SURGEON'S POCKET-BOOK: an Essay on the Best Treatment of the Wounded in War; for which a Prize was awarded by Her Majesty the Empress of Germany. Specially adapted to the PUBLIC MEDICAL SERVICES. With 152 Illustrations and folding-plate, fcp. 8vo, roan, 7/6. *Third Edition, Revised and Enlarged.* By Brigade-Surgeon C. H. Y. GODWIN, of the Army Medical School.

"Every Medical Officer is recommended to have the 'Surgeon's Pocket-Book' by Surgeon-Major Porter, accessible to refresh his memory and fortify his judgment."—*Précis of Field-Service Medical Arrangements for Afghan War.*
"A complete *vade mecum* to guide the military surgeon in the field."—*British Medical Journal.*
"A capital little book of the greatest practical value. . . . A surgeon with this Manual in his pocket becomes a man of resource at once."—*Westminster Review.*

SEXTON (A. Humboldt, F.C.S., Professor of Metallurgy, Glasgow and West of Scotland Technical College):

1. QUANTITATIVE ANALYSIS (Outlines of). For the Use of Students. With Numerous Illustrations. *Third Edition.* Crown 8vo. Cloth, 3/.

"A good and useful book. . . . Really supplies a want."—*The Lancet.*
"This is an admirable little volume, and well fulfils its purpose."—*Schoolmaster.*

2. QUALITATIVE ANALYSIS (Outlines of). For the use of Students. With numerous Illustrations. *Second Edition.* Crown 8vo. Cloth, 3/6.

"The Work of a thorough practical Chemist . . . and one which may be unhesitatingly recommended."—*Brit. Medical Journal.*

STIRLING (William, M.D., D.Sc., Owens College, Manchester):

A TEXT-BOOK OF HUMAN PHYSIOLOGY (*See under Landois and Stirling, page* 10). *Third Edition.*

OUTLINES OF PRACTICAL PHYSIOLOGY: including Experimental and Chemical Physiology. With special reference to Clinical Medicine. A Laboratory Handbook for the use of Students. With 142 Illustrations. In large Crown 8vo, 8/6.

"An excellent treatise, which we can thoroughly recommend."—*Lancet.*

"May be confidently recommended as a guide to the Student of Physiology."—*Glasgow Medical Journal.*

OUTLINES OF PRACTICAL HISTOLOGY. With 344 Illustrations. Large Crown 8vo. Cloth, 12/6.

THORBURN (John, M.D., F.R.C.P., Late Professor of Obstetric Medicine, Owens College and Victoria University, Manchester; Obstetric Physician to the Manchester Royal Infirmary):

THE DISEASES OF WOMEN (A Practical Treatise on). Prepared with Special Reference to the Wants of the General Practitioner and Advanced Student. With Chromo-lithograph, and over 200 Illustrations. Royal 8vo, handsome cloth, 21/.

The ENTIRE WORK is IMPARTIAL and INSTRUCTIVE, and in every way worthy of its author."—*British Medical Journal.*

THORBURN (Wm., B.S., B.Sc., M.D., F.R.C.S., Assistant-Surgeon to the Manchester Royal Infirmary):

THE SURGERY OF THE SPINAL CORD (A Contribution to). With Diagrams, Tables, and Illustrations. Medium 8vo. Handsome cloth, 12s. 6d.

THORNTON (J. Knowsley, M.B., M.C., Surgeon to the Samaritan Free Hospital for Women, &c., &c.):

THE SURGERY OF THE KIDNEYS. Being the Harveian Lectures for 1889. With Illustrations and Tables. Demy 8vo. Cloth, 5s.

GENERAL SCIENTIFIC AND TECHNICAL WORKS.

BERINGER (C., F.I.C., F.C.S., late Chief Assayer to the Rio Tinto Company); and BERINGER (J. J., F.I.C., F.C.S., Public Analyst for, and Lecturer to the Mining Association of, Cornwall):

ASSAYING (A Text-Book of): for the Use of Students, Mine Managers, Assayers, &c. With numerous Tables and Illustrations. Crown 8vo. Cloth, 10/6.

"A REALLY MERITORIOUS WORK, that may be safely depended upon either for systematic instruction or for reference."—*Nature.*

BROWNE (Walter R., M.A., M. Inst. C.E., F.G.S., late Fellow of Trinity College, Cambridge):

THE STUDENT'S MECHANICS: An Introduction to the Study of Force and Motion. With Diagrams. Crown 8vo. Cloth, 4/6.

"Clear in style and practical in method, 'THE STUDENT'S MECHANICS,' is cordially to be recommended from all points of view. . . . Will be of great value to Students desirous to gain full knowledge."—*Athenæum.*

"The merits of the work are especially conspicuous in its clearness and brevity . . . deserves the attention of all who have to teach or learn the elements of Mechanics. . . . An excellent conception."—*Westminster Review.*

—— FOUNDATIONS OF MECHANICS. Papers reprinted from the *Engineer.* In crown 8vo, 1/.

—— FUEL AND WATER: A Manual for Users of Steam and Water. By Prof. SCHWACKHÖFER and W. R. BROWNE, M.A. (See p. 23.)

BROUGH (B. H., F.G.S., Instructor of Mine Surveying, Royal School of Mines):

MINE SURVEYING (A Text-Book of): for the Use of Managers of Mines and Collieries, Students at the Royal School of Mines, City and Guilds of London Institute, &c. With Illustrations. *Second Edition.* Crown 8vo, cloth, 7/6.

"Supplies a long-felt want."—*Iron.*

"A valuable accessory to Surveyors in every department of commercial enterprise." —*Colliery Guardian.*

"The information is given in a concise manner."—*Engineering.*

CRIMP (W. Santo, A. M. Inst. C. E., F. G. S., Assistant-Engineer to the London County Council):

SEWAGE DISPOSAL WORKS. A Guide to the Construction of Works for the Prevention of the Pollution of Rivers and Estuaries. With 33 Lithographic Plates, Tables, and Illustrations in the Text. Medium 8vo, Cloth, 25/.

GURDEN (Richard Lloyd, Authorised Surveyor for the Governments of New South Wales and Victoria):

TRAVERSE TABLES: computed to Four Places Decimals for every Minute of Angle up to 100 of Distance. For the use of Surveyors and Engineers. *Second Edition.* Folio, strongly half-bound, 21/.

*** *Published with Concurrence of the Surveyors-General for New South Wales and Victoria.*

"Those who have experience in exact SURVEY-WORK will best know how to appreciate the enormous amount of labour represented by this valuable book. The computations enable the user to ascertain the sines and cosines for a distance of twelve miles to within half an inch, and this BY REFERENCE TO BUT ONE TABLE, in place of the usual Fifteen minute computations required. This alone is evidence of the assistance which the Tables ensure to every user, and as every Surveyor in active practice has felt the want of such assistance, few knowing of their publication will remain without them."—*Engineer.*

"We cannot sufficiently admire the heroic patience of the author, who, in order to prevent error, calculated each result by two different modes, and, before the work was finally placed in the Printers' hands, repeated the operation for a third time, on revising the proofs."—*Engineering.*

JAMES (W. Powell, M.A.):

FROM SOURCE TO SEA: or, Gleanings about Rivers from many Fields. A Chapter in Physical Geography. Cloth elegant, 3/6.

"Excellent reading . . . a book of popular science which deserves an extensive circulation."—*Saturday Review.*

JAMIESON (Andrew, C.E., F.R.S.E., Professor of Engineering, Glasgow and West of Scotland Technical College):

STEAM AND THE STEAM ENGINE (A Text-Book on): Specially arranged for the use of Science and Art, City and Guilds' of London Institute, and other Engineering Students. With 200 Illustrations and Four Folding-Plates. *Fifth Edition.* Crown 8vo. Cloth, 7/6.

"The BEST BOOK yet published for the use of Students."—*Engineer.*

"This is undoubtedly the MOST VALUABLE and MOST COMPLETE hand-book of reference on the subject that now exists."—*Marine Engineer.*

1. STEAM AND THE STEAM ENGINE (An Elementary Manual on), forming an introduction to the larger Work by the same Author. With numerous Illustrations and Examination Questions at the end of each Lecture. *Second Edition.* Crown 8vo. Cloth, 3/6.

2. MAGNETISM AND ELECTRICITY (An Elementary Manual on). With numerous Illustrations and Examination Questions. Part I.—Magnetism. Crown 8vo, 1s. Part II.—Voltaic Electricity. 1s. 6d.

3. APPLIED MECHANICS (An Elementary Manual on). With Diagrams and Examination Questions. Crown 8vo.

MUNRO (John, C. E.) and JAMIESON (Andrew, C.E., F.R.S.E.):

A POCKET-BOOK OF ELECTRICAL RULES AND TABLES, for the use of Electricians and Engineers. Pocket Size. Leather, 8/6. *Sixth Edition, revised and enlarged.* With numerous Diagrams.

*** The SIXTH EDITION has been thoroughly Revised and Enlarged by about 120 pages and 60 new Figures.

"WONDERFULLY PERFECT. . . . Worthy of the highest commendation we can give it."—*Electrician.*

"The STERLING VALUE of Messrs. MUNRO and JAMIESON'S POCKET-BOOK."—*Electrical Review.*

MUNRO (R. D.), STEAM BOILERS: Their

Defects, Management, and Construction. A Manual for all concerned in the care of Steam Boilers, but written with a special view to the wants of Boiler-Attendants, Mill-Mechanics, and other Artisans. With Numerous Illustrations. Crown 8vo, Cloth 3/6.

"The volume is a valuable companion for workmen and engineers engaged about Steam Boilers, and ought to be carefully studied, and always at hand."—*Colliery Guardian.*

"The subjects referred to are handled in a trustworthy, clear, and practical manner. . . . The book is VERY USEFUL, especially to steam users, artisans, and young engineers."—*Engineer.*

NAPIER (James, F.R.S.E., F.C.S.):

A MANUAL OF THE ART OF DYEING AND DYEING RECEIPTS. Illustrated by Diagrams and Numerous Specimens of Dyed Cotton, Silk, and Woollen Fabrics. Demy 8vo. *Third Edition, thoroughly revised and greatly enlarged.* Cloth, 21/.

PHILLIPS (J. Arthur, F.R.S., M. Inst. C.E., F.C.S., F.G.S., Ancien Elève de l'Ecole des Mines, Paris):

ELEMENTS OF METALLURGY: a Practical Treatise on the Art of Extracting Metals from their Ores. With over 200 Illustrations, many of which have been reduced from Working Drawings, and two Folding-Plates. Royal 8vo, 848 pages, cloth, 36/. *NEW EDITION by the Author and Mr. H. Bauerman, F.G.S.*

General Contents.

I.—A TREATISE on FUELS and REFRACTORY MATERIALS.
II.—A Description of the principal MINERALS, with their DISTRIBUTION.
III.—STATISTICS of the amount of each METAL annually produced throughout the World.
IV.—The METHODS of ASSAYING the different ORES, together with the PROCESSES of METALLURGICAL TREATMENT.

"'Elements of Metallurgy' possesses intrinsic merits of the highest degree. Such a work is precisely wanted by the great majority of students and practical workers, and its very compactness is in itself a first-rate recommendation. . . . In our opinion, the BEST WORK EVER WRITTEN ON THE SUBJECT with a view to its practical treatment."—*Westminster Review.*

"The VALUE OF THIS WORK IS ALMOST INESTIMABLE. There can be no question that the amount of time and labour bestowed upon it is enormous. . . . There is certainly no Metallurgical Treatise in the language calculated to prove of such general utility."—*Mining Journal.*

MANY NOTABLE ADDITIONS

WILL BE FOUND IN THE SECTIONS DEVOTED TO

IRON, LEAD, COPPER, SILVER, AND GOLD,

Dealing with New Processes and Development.

SCIENTIFIC MANUALS

BY

W. J. MACQUORN RANKINE, C.E., LL.D., F.R.S.,

Late Regius Professor of Civil Engineering in the University of Glasgow.

THOROUGHLY REVISED BY W. J. MILLAR, C.E.,

Secretary to the Institute of Engineers and Shipbuilders in Scotland.

In Crown 8vo. Cloth.

I. RANKINE (Prof.): APPLIED MECHANICS: comprising the Principles of Statics and Cinematics, and Theory of Structures, Mechanism, and Machines. With numerous Diagrams. *Twelfth Edition*, 12/6.

"Cannot fail to be adopted as a text-book. . . . The whole of the information is so admirably arranged that there is every facility for reference."—*Mining Journal.*

II. RANKINE (Prof.): CIVIL ENGINEERING: comprising Engineering Surveys, Earthwork, Foundations, Masonry, Carpentry, Metal-work, Roads, Railways, Canals, Rivers, Water-works, Harbours, &c. With numerous Tables and Illustrations. *Seventeenth Edition*, 16/.

"Far surpasses in merit every existing work of the kind. As a manual for the hands of the professional Civil Engineer it is sufficient and unrivalled, and even when we say this, we fall short of that high appreciation of Dr. Rankine's labours which we should like to express."—*The Engineer.*

III. RANKINE (Prof.): MACHINERY AND MILLWORK: comprising the Geometry, Motions, Work, Strength, Construction, and Objects of Machines, &c. Illustrated with nearly 300 Woodcuts. *Sixth Edition*, 12/6.

"Professor Rankine's 'Manual of Machinery and Millwork' fully maintains the high reputation which he enjoys as a scientific author; higher praise it is difficult to award to any book. It cannot fail to be a lantern to the feet of every engineer."—*The Engineer.*

IV. RANKINE (Prof.): THE STEAM ENGINE and OTHER PRIME MOVERS. With Diagram of the Mechanical Properties of Steam, Folding-Plates, numerous Tables and Illustrations. *Twelfth Edition*, 12/6.

V. RANKINE (Prof.): USEFUL RULES and TABLES for Engineers and others. With Appendix: TABLES, TESTS, and FORMULÆ for the use of ELECTRICAL ENGINEERS; comprising Submarine Electrical Engineering, Electric Lighting, and Transmission of Power. By ANDREW JAMIESON, C.E., F.R.S.E. *Seventh Edition*, 10/6.

"Undoubtedly the most useful collection of engineering data hitherto produced."—*Mining Journal.*

"Every Electrician will consult it with profit."—*Engineering.*

VI. RANKINE (Prof.): A MECHANICAL TEXT-BOOK. by Prof. MACQUORN RANKINE and E. F. BAMBER, C.E. With numerous Illustrations. *Third Edition*, 9/.

"The work, as a whole, is very complete, and likely to prove invaluable for furnishing a useful and reliable outline of the subjects treated of."—*Mining Journal.*

*** THE MECHANICAL TEXT-BOOK forms a simple introduction to PROFESSOR RANKINE'S SERIES of MANUALS on ENGINEERING and MECHANICS.

PROF. RANKINE'S WORKS—(*Continued*).

VII. RANKINE (Prof.): MISCELLANEOUS SCIENTIFIC PAPERS. Royal 8vo. Cloth, 31/6.

Part I. Papers relating to Temperature, Elasticity, and Expansion of Vapours, Liquids, and Solids. Part II. Papers on Energy and its Transformations. Part III. Papers on Wave-Forms, Propulsion of Vessels, &c.

With Memoir by Professor TAIT, M.A. Edited by W. J. MILLAR, C.E. With fine Portrait on Steel, Plates, and Diagrams.

"No more enduring Memorial of Professor Rankine could be devised than the publication of these papers in an accessible form. . . . The Collection is most valuable on account of the nature of his discoveries, and the beauty and completeness of his analysis. . . . The Volume exceeds in importance any work in the same department published in our time."—*Architect.*

By SIR EDWARD REED.

Royal 8vo, Handsome Cloth, 25s.

THE STABILITY OF SHIPS.

BY

SIR EDWARD J. REED, K.C.B., F.R.S., M.P.,

KNIGHT OF THE IMPERIAL ORDERS OF ST. STANILAUS OF RUSSIA; FRANCIS JOSEPH OF AUSTRIA; MEDJIDIE OF TURKEY; AND RISING SUN OF JAPAN; VICE-PRESIDENT OF THE INSTITUTION OF NAVAL ARCHITECTS.

With numerous Illustrations and Tables.

THIS work has been written for the purpose of placing in the hands of Naval Constructors, Shipbuilders, Officers of the Royal and Mercantile Marines, and all Students of Naval Science, a complete Treatise upon the Stability of Ships, and is the only work in the English Language dealing exhaustively with the subject.

The plan upon which it has been designed is that of deriving the fundamental principles and definitions from the most elementary forms of floating bodies, so that they may be clearly understood without the aid of mathematics; advancing thence to all the higher and more mathematical developments of the subject.

The work also embodies a very full account of the historical rise and progress of the Stability question, setting forth the results of the labours of BOUGUER, BERNOULLI, DON JUAN D'ULLOA, EULER, CHAPMAN, and ROMME, together with those of our own Countrymen, ATWOOD, MOSELEY, and a number of others.

The modern developments of the subject, both home and foreign, are likewise treated with much fulness, and brought down to the very latest date, so as to include the labours not only of DARGNIES, REECH (whose famous *Mémoire*, hitherto a sealed book to the majority of English naval architects, has been reproduced in the present work), RISBEC, FERRANTY, DUPIN, GUYOU, and DAYMARD, in France, but also those of RANKINE, WOOLLEY, ELGAR, JOHN, WHITE, GRAY, DENNY, INGLIS, and BENJAMIN, in Great Britain.

In order to render the work complete for the purposes of the Shipbuilder, whether at home or abroad, the Methods of Calculation introduced by Mr. F. K. BARNES, Mr. GRAY, M. REECH, M. DAYMARD, and Mr. BENJAMIN, are all given separately, illustrated by Tables and worked-out examples. The book contains more than 200 Diagrams, and is illustrated by a large number of actual cases, derived from ships of all descriptions, but especially from ships of the Mercantile Marine.

The work will thus be found to constitute the most comprehensive and exhaustive Treatise hitherto presented to the Profession on the Science of the STABILITY OF SHIPS.

"Sir EDWARD REED'S 'STABILITY OF SHIPS' is INVALUABLE. In it the STUDENT, new to the subject, will find the path prepared for him, and all difficulties explained with the utmost care and accuracy; the SHIP-DRAUGHTSMAN will find all the methods of calculation at present in use fully explained and illustrated, and accompanied by the Tables and Forms employed; the SHIPOWNER will find the variations in the Stability of Ships due to differences in forms and dimensions fully discussed, and the devices by which the state of his ships under all conditions may be graphically represented and easily understood; the NAVAL ARCHITECT will find brought together and ready to his hand, a mass of information which he would otherwise have to seek in an almost endless variety of publications, and some of which he would possibly not be able to obtain at all elsewhere."—*Steamship.*

SCHWACKHÖFER and BROWNE:

FUEL AND WATER: A Manual for Users of Steam and Water. By Prof. FRANZ SCHWACKHÖFER of Vienna, and WALTER R. BROWNE, M.A., C.E., late Fellow of Trinity College, Cambridge. Demy 8vo, with Numerous Illustrations, 9/.

"The Section on Heat is one of the best and most lucid ever written."—*Engineer.*

"Contains a vast amount of useful knowledge. . . . Cannot fail to be valuable to thousands compelled to use steam power."—*Railway Engineer.*

"Its practical utility is beyond question."—*Mining Journal.*

SEATON (A. E., Lecturer on Marine Engineering at the Royal Naval College, Greenwich, and Member of the Institute of Naval Architects):

A MANUAL OF MARINE ENGINEERING; Comprising the Designing, Construction, and Working of Marine Machinery. With numerous Illustrations. *Eighth Edition.* Demy 8vo. Cloth, 18/.

Opinions of the Press.

"The important subject of Marine Engineering is here treated with the thoroughness that it requires. No department has escaped attention. . . . Gives the results of much close study and practical work."—*Engineering.*

"By far the best MANUAL in existence. . . . Gives a complete account of the methods of solving, with the utmost possible economy, the problems before the Marine Engineer."—*Athenæum.*

"In the three-fold capacity of enabling a Student to learn how to design, construct, and work a modern Marine Steam-Engine, Mr. Seaton's Manual has no rival."—*Times.*

"The Student, Draughtsman, and Engineer will find this work the most valuable Handbook of Reference on the Marine Engine now in existence."—*Marine Engineer.*

SHELTON-BEY (W. Vincent, Foreman to the Imperial Ottoman Gun Factories, Constantinople):

THE MECHANIC'S GUIDE: A Hand-Book for Engineers and Artizans. With Copious Tables and Valuable Recipes for Practical Use. Illustrated. *Second Edition.* Crown 8vo. Cloth, 7/6.

"The MECHANIC'S GUIDE will answer its purpose as completely as a whole series of elaborate text-books."—*Mining Journal.*

TRAILL (Thomas W., F.E.R.N., M.Inst.C.E., Engineer-Surveyor-in-Chief to the Board of Trade):

BOILERS: THEIR CONSTRUCTION AND STRENGTH. A Handbook of Rules, Formulæ, and Tables for the Construction of Boilers; Safety-Valves; Material for Boilers; Tables of Areas, &c. Arranged for the Use of Steam-Users. *Second Edition,* Revised and Enlarged. Pocket-Size, Leather, 12s.; also for Office-Use, Cloth, 12s.

*** In the New Issue the subject matter has been considerably extended; Tables have been added for Pressures up to 200 lb. per square inch, and some of the Table have been altered, besides which new ones and other matter have been introduced, which have been specially prepared and computed for the SECOND EDITION.

"Contains an enormous quantity of information—to be had nowhere else—arranged in a very convenient form. It is admirably printed, and reflects credit on the Publishers." *Engineer.*

"Will prove a welcome and valuable addition to the literature of the subject. . . . We can strongly recommend Mr. Traill's book as being the most complete, eminently practical, and most recent work on Boilers."—*Marine Engineer.*

"Will prove INVALUABLE to the Engineer and Practical Boiler-maker."—*Practical Engineer.*

OFFICIAL YEAR-BOOK

OF THE

SCIENTIFIC AND LEARNED SOCIETIES OF GREAT BRITAIN AND IRELAND. PRICE 7/6.

COMPILED FROM OFFICIAL SOURCES. SEVENTH ANNUAL ISSUE.

Comprising (together with other Official Information) LISTS of the PAPERS read during 1889 before the ROYAL SOCIETIES of LONDON and EDINBURGH, the ROYAL DUBLIN SOCIETY, the BRITISH ASSOCIATION, and all the LEADING SOCIETIES throughout the Kingdom engaged in the following Departments of Research:—

§ 1. Science Generally: *i.e.*, Societies occupying themselves with several Branches of Science, or with Science and Literature jointly.
§ 2. Mathematics and Physics.
§ 3. Chemistry and Photography.
§ 4. Geology, Geography, and Mineralogy.
§ 5. Biology, including Microscopy and Anthropology.
§ 6. Economic Science and Statistics.
§ 7. Mechanical Science and Architecture.
§ 8. Naval and Military Science.
§ 9. Agriculture and Horticulture.
§ 10. Law.
§ 11. Medicine.
§ 12. Literatnre.
§ 13. Psychology.
§ 14. Archæology.

"The YEAR-BOOK OF SOCIETIES is a Record which ought to be of the greatest use for the progress of Science."—*Sir Lyon Playfair, F.R.S., K.C.B., M.P., Past-President of the British Association.*

"It goes almost without saying that a Handbook of this subject will be in time one of the most generally useful works for the library or the desk."—*The Times.*

"The YEAR-BOOK OF SOCIETIES meets an obvious want, and promises to be a valuable work of reference."—*Athenæum.*

"The YEAR-BOOK OF SCIENTIFIC AND LEARNED SOCIETIES meets a want, and is therefore sure of a welcome."—*Westminster Review.*

"In the YEAR-BOOK OF SOCIETIES we have the FIRST ISSUE of what is, without doubt, a very useful work."—*Spectator.*

"The YEAR-BOOK OF SOCIETIES fills a very real want. The volume will become a Scientific Directory, chronicling the work and discoveries of the year, and enabling the worker in one branch to try his hand in all that interests him in kindred lines of research. We trust that it will meet with an encouraging reception."—*Engineering.*

"The OFFICIAL YEAR-BOOK OF SOCIETIES, which has been prepared to meet a want long felt by scientific workers of a Representative Book, will form a yearly record of Scientific Progress, and a Handbook of Reference. . . . It is carefully printed, and altogether well got up."—*Public Opinion.*

Copies of the FIRST ISSUE, giving an Account of the History, Organisation, and Conditions of Membership of the various Societies [with Appendix on the Leading Scientific Societies throughout the world], and forming the groundwork of the Series, may still be had, price 7/6. *Also Copies of the following Issues.*

The YEAR-BOOK OF SOCIETIES forms a complete INDEX TO THE SCIENTIFIC WORK of the year in the various Departments. It is used as a ready HANDBOOK in all our great SCIENTIFIC CENTRES, MUSEUMS, and LIBRARIES throughout the Kingdom, and will, without doubt, become an INDISPENSABLE BOOK OF REFERENCE to every one engaged in Scientific Work.

"We predict that the YEAR-BOOK OF SOCIETIES will speedily become one of those Year-Books WHICH IT WOULD BE IMPOSSIBLE TO DO WITHOUT."—*Bristol Mercury.*

EDUCATIONAL WORKS.

*** *Specimen Copies of all the Educational Works published by Messrs. Charles Griffin and Company may be seen at the Libraries of the College of Preceptors, South Kensington Museum, and Crystal Palace; also at the depôts of the Chief Educational Societies.*

BRYCE (Archibald Hamilton, D.C.L., LL.D.,

Senior Classical Moderator in the University of Dublin):

THE WORKS OF VIRGIL. Text from HEYNE and WAGNER. English Notes, original, and selected from the leading German and English Commentators. Illustrations from the antique. Complete in One Volume. *Fourteenth Edition.* Fcap 8vo. Cloth, 6/.

Or, in Three Parts:

Part I. BUCOLICS and GEORGICS, . . 2/6.
Part II. THE ÆNEID, Books I.–VI., . 2/6.
Part III. THE ÆNEID, Books VII.–XII., . 2/6.

"Contains the pith of what has been written by the best scholars on the subject. . . . The notes comprise everything that the student can want."—*Athenæum.*

"The most complete, as well as elegant and correct edition of Virgil ever published in this country."—*Educational Times.*

"The best commentary on Virgil which a student can obtain."—*Scotsman.*

COBBETT (William): ENGLISH GRAMMAR,

in a Series of Letters, intended for the use of Schools and Young Persons in general. With an additional chapter on Pronunciation, by the Author's Son, JAMES PAUL COBBETT. *The only correct and authorised Edition.* Fcap 8vo. Cloth, 1/6.

"A new and cheapened edition of that most excellent of all English Grammars, William Cobbett's. It contains new copyright matter, as well as includes the equally amusing and instructive 'Six Lessons intended to prevent Statesmen from writing in an awkward manner.'"—*Atlas.*

COBBETT (William): FRENCH GRAMMAR.

Fifteenth Edition. Fcap 8vo. Cloth, 3/6.

"Cobbett's 'French Grammar' comes out with perennial freshness. There are few grammars equal to it for those who are learning, or desirous of learning, French without a teacher. The work is excellently arranged, and in the present edition we note certain careful and wise revisions of the text."—*School Board Chronicle.*

"Business men commencing the study of French will find this treatise one of the best aids. . . . It is largely used on the Continent."—*Midland Counties Herald.*

COBBIN'S MANGNALL: MANGNALL'S

HISTORICAL AND MISCELLANEOUS QUESTIONS, for the use of Young People. By RICHMAL MANGNALL. Greatly enlarged and corrected, and continued to the present time, by INGRAM COBBIN, M.A. *Fifty-fourth Thousand. New Illustrated Edition.* 12mo. Cloth, 4/.

COLERIDGE (Samuel Taylor): A DISSERTATION ON THE SCIENCE OF METHOD. (*Encyclopædia Metropolitana.*) With a Synopsis. *Ninth Edition.* Cr. 8vo. Cloth, 2/.

CRAIK'S ENGLISH LITERATURE.

A COMPENDIOUS HISTORY OF ENGLISH LITERATURE AND OF THE ENGLISH LANGUAGE FROM THE NORMAN CONQUEST. With numerous Specimens. By GEORGE LILLIE CRAIK, LL.D., late Professor of History and English Literature, Queen's College, Belfast. *New Edition.* In two vols. Royal 8vo. Handsomely bound in cloth, 25/.

GENERAL CONTENTS.

INTRODUCTORY.

I.—THE NORMAN PERIOD—The Conquest.
II.—SECOND ENGLISH—Commonly called Semi-Saxon.
III.—THIRD ENGLISH—Mixed, or Compound English.
IV.—MIDDLE AND LATTER PART OF THE SEVENTEENTH CENTURY.
V.—THE CENTURY BETWEEN THE ENGLISH REVOLUTION AND THE FRENCH REVOLUTION.
VI.—THE LATTER PART OF THE EIGHTEENTH CENTURY.
VII.—THE NINETEENTH CENTURY (*a*) THE LAST AGE OF THE GEORGES.
(*b*) THE VICTORIAN AGE.

With numerous Excerpts and Specimens of Style.

"Anyone who will take the trouble to ascertain the fact, will find how completely even our great poets and other writers of the last generation have already faded from the view of the present, with the most numerous class of the educated and reading public. Scarcely anything is generally read except the publications of the day. YET NOTHING IS MORE CERTAIN THAN THAT NO TRUE CULTIVATION CAN BE SO ACQUIRED. This is the extreme case of that entire ignorance of history which has been affirmed, not with more point than truth, to leave a person always a child. . . . The present work combines the HISTORY OF THE LITERATURE with the HISTORY OF THE LANGUAGE. The scheme of the course and revolutions of the language which is followed here is extremely simple, and resting not upon arbitrary, but upon natural or real distinctions, gives us the only view of the subject that can claim to be regarded as of a scientific character."—*Extract from the Author's Preface.*

"Professor Craik has succeeded in making a book more than usually agreeable."—*The Times.*

CRAIK (Prof.): A MANUAL OF ENGLISH LITERATURE, for the use of Colleges, Schools, and Civil Service Examinations. Selected from the larger work, by Dr. CRAIK. *Tenth Edition.* With an Additional Section on Recent Literature, by HENRY CRAIK, M.A., Author of "A Life of Swift." Crown 8vo. Cloth, 7/6.

"A Manual of English Literature from so experienced and well-read a scholar as Professor Craik needs no other recommendation than the mention of its existence."—*Spectator.*

"This augmented effort will, we doubt not, be received with decided approbation by those who are entitled to judge, and studied with much profit by those who want to learn. . . . If our young readers will give healthy perusal to Dr. Craik's work, they will greatly benefit by the wide and sound views he has placed before them."—*Athenæum.*

"The preparation of the NEW ISSUE has been entrusted to Mr. HENRY CRAIK, Secretary to the Scotch Education Department, and well known in literary circles as the author of the latest and best Life of Swift. . . . A Series of TEST QUESTIONS is added, which must prove of great service to Students studying alone."—*Glasgow Herald.*

WORKS BY REV. C. T. CRUTTWELL, M.A.,

Late Fellow of Merton College, Oxford.

I.—A HISTORY OF ROMAN LITERATURE:

From the Earliest Period to the Times of the Antonines. *Fourth Edition.* Crown 8vo. Cloth, 8/6.

"Mr. CRUTTWELL has done a real service to all Students of the Latin Language and Literature. . . . Full of good scholarship and good criticism."—*Athenæum.*

"A most serviceable—indeed, indispensable—guide for the Student. . . . The 'general reader' will be both charmed and instructed."—*Saturday Review.*

"The Author undertakes to make Latin Literature interesting, and he has succeeded. There is not a dull page in the volume."—*Academy.*

"The great merit of the work is its fulness and accuracy."—*Guardian.*

"This elaborate and careful work, in every respect of high merit. Nothing at all equal to it has hitherto been published in England."—*British Quarterly Review.*

Companion Volume. Second Edition.

II.—SPECIMENS OF ROMAN LITERATURE:

From the Earliest Period to the Times of the Antonines. Passages from the Works of Latin Authors, Prose Writers, and Poets:

Part I.—ROMAN THOUGHT: Religion, Philosophy and Science, Art and Letters, 6/.

Part II.—ROMAN STYLE: Descriptive, Rhetorical, and Humorous Passages, 5/.

Or in One Volume complete, 10/6.

Edited by C. T. CRUTTWELL, M.A., Merton College, Oxford; and PEAKE BANTON, M.A., some time Scholar of Jesus College, Oxford.

"'Specimens of Roman Literature' marks a new era in the study of Latin."—*English Churchman.*

"A work which is not only useful but necessary. . . . The plan gives it a standing-ground of its own. . . . The sound judgment exercised in plan and selection calls for hearty commendation."—*Saturday Review.*

"It is hard to conceive a completer or handier repertory of specimens of Latin thought and style."—*Contemporary Review.*

*** KEY to PART II., PERIOD II. (being a complete TRANSLATION of the 85 Passages composing the Section), by THOS. JOHNSTON, M.A., may now be had (by Tutors and Schoolmasters only) on application to the Publishers. Price 2/6.

III.—A HISTORY OF EARLY CHRISTIAN LITERATURE.

For the use of Students and General Readers. 8vo, Handsome Cloth. [*In Preparation.*

CURRIE (Joseph, formerly Head Classical Master of Glasgow Academy):

THE WORKS OF HORACE: Text from ORELLIUS. English Notes, original, and selected from the best Commentators. Illustrations from the antique. Complete in One Volume. Fcap 8vo. Cloth, 5/.

Or in Two Parts:

Part I.—CARMINA, ... 3/.
Part II.—SATIRES AND EPISTLES, . . 3/.

"The notes are excellent and exhaustive."—*Quarterly Journal of Education.*

—— EXTRACTS FROM CÆSAR'S COMMENTARIES;

containing his description of Gaul, Britain, and Germany. With Notes, Vocabulary, &c. Adapted for Young Scholars. *Fourth Edition.* 18mo. Cloth, 1/6.

McBURNEY (Isaiah, LL.D.,): EXTRACTS FROM OVID'S METAMORPHOSES. With Notes, Vocabulary, &c. Adapted for Young Scholars. *Third Edition.* 18mo. Cloth, 1/6.

MENTAL SCIENCE: S. T. COLERIDGE'S celebrated Essay on METHOD; Archbishop WHATELY'S Treatises on LOGIC and RHETORIC. *Tenth Edition.* Crown 8vo. Cloth, 5/.

MILLER (W. Galbraith, M.A., LL.B., Lecturer on Public Law, including Jurisprudence and International Law, in the University of Glasgow):

THE PHILOSOPHY OF LAW, LECTURES ON. Designed mainly as an Introduction to the Study of International Law. In 8vo. Handsome Cloth, 12/. *Now Ready.*

"Mr. MILLER'S 'PHILOSOPHY OF LAW' bears upon it the stamp of a wide culture and of an easy acquaintanceship with what is best in modern continental speculation. . . . Interesting and valuable, because suggestive."—*Journal of Jurisprudence.*

WORKS BY WILLIAM RAMSAY, M.A.,

Trinity College, Cambridge, late Professor of Humanity in the University of Glasgow.

A MANUAL OF ROMAN ANTIQUITIES. For the use of Advanced Students. With Map, 130 Engravings, and very copious Index. *Fourteenth Edition.* Crown 8vo. Cloth, 8/6.

"Comprises all the results of modern improved scholarship within a moderate compass."—*Athenæum.*

—— AN ELEMENTARY MANUAL OF ROMAN ANTIQUITIES. Adapted for Junior Classes. With numerous Illustrations. *Eighth Edition.* Crown 8vo. Cloth, 4/.

—— A MANUAL OF LATIN PROSODY, Illustrated by Copious Examples and Critical Remarks. For the use of Advanced Students. *Seventh Edition.* Crown 8vo. Cloth, 5/.

"There is no other work on the subject worthy to compete with it."—*Athenæum.*

—— AN ELEMENTARY MANUAL OF LATIN PROSODY. Adapted for Junior Classes. Crown 8vo. Cloth, 2s.

THE SCHOOL BOARD READERS:

A SERIES OF STANDARD READING-BOOKS.

EDITED BY A FORMER H.M. INSPECTOR OF SCHOOLS.

Adopted by many School Boards throughout the Country.

Elementary Reader, Part I.,	1d.	Standard III.,	9d.
,, ,, ,, II.,	2d.	,, IV.,	1s. 0d.
Standard I.,	4d.	,, V.,	1s. 6d.
,, II.,	6d.	,, VI.,	2s. 0d.

Key to the Questions in Arithmetic in 2 Parts, each 6d.

"THE BOOKS GENERALLY ARE VERY MUCH WHAT WE SHOULD DESIRE."—*Times.*
"The Series is DECIDEDLY ONE OF THE BEST that have yet appeared."—*Athenæum.*

THE SCHOOL BOARD MANUALS

ON THE SPECIFIC SUBJECTS OF THE REVISED CODE,

BY A FORMER H.M. INSPECTOR OF SCHOOLS,

Editor of the "School Board Readers."

64 pages, stiff wrapper. 6*d.*; neat cloth, 7*d.* each.

I.—ALGEBRA.
II.—ENGLISH HISTORY.
III.—GEOGRAPHY.
IV.—PHYSICAL GEOGRAPHY.
V.—ANIMAL PHYSIOLOGY. (Well Illustrated with good Engravings.)
VI.—BIBLE HISTORY. (Entirely free from any Denominational bias.)

SCHRADER (Dr. O.) and JEVONS (F. B., M.A.): THE PREHISTORIC ANTIQUITIES OF THE ARYAN PEOPLES: Translated from the SECOND GERMAN EDITION by F. B. Jevons, M.A., author of "*A History of Greek Literature.*" Demy 8vo. Handsome cloth, gilt top, 21/.

*** The Publishers have pleasure in announcing that to the English Translation of Dr. Schrader's well-known "*Sprachvergleichung und Urgeschichte*"—a work which commends itself alike to the Scholar by its thoroughness and the moderation of its tone, and to the General Reader by its clear and interesting style—an INTRODUCTION is furnished by the AUTHOR.

SENIOR (Nassau William, M.A., late Professor of Political Economy in the University of Oxford): A TREATISE ON POLITICAL ECONOMY: the Science which treats of the Nature, the Production, and the Distribution of Wealth. *Sixth Edition.* Crown 8vo. Cloth. (*Encyclopædia Metropolitana*), 4/.

THOMSON (James): THE SEASONS. With an Introduction and Notes by ROBERT BELL, Editor of the "Annotated Series of British Poets." *Third Edition.* Fcap 8vo. Cloth, 1/6.

"An admirable introduction to the study of our English classics."

WHATELY (Archbishop): LOGIC—A Treatise on. With Synopsis and Index. (*Encyclopædia Metropolitana*), 3/.

——— RHETORIC—A Treatise on. With Synopsis and Index. (*Encyclopædia Metropolitana*), 3/6.

WORKS IN GENERAL LITERATURE.

BELL (Robert, Editor of the "Annotated Series of British Poets"):

GOLDEN LEAVES FROM THE WORKS OF THE POETS AND PAINTERS. Illustrated by Sixty-four superb Engravings on Steel, after Paintings by DAVID ROBERTS, STANFIELD, LESLIE, STOTHARD, HAYDON, CATTERMOLE, NASMYTH, Sir THOMAS LAWRENCE, and many others, and engraved in the first style of Art by FINDEN, GREATBACH, LIGHTFOOT, &c. *Second Edition.* 4to. Cloth gilt, 21/.

"'Golden Leaves' is by far the most important book of the season. The Illustrations are really works of art, and the volume does credit to the arts of England."—*Saturday Review.*

"The Poems are selected with taste and judgment."—*Times.*

"The engravings are from drawings by Stothard, Newton, Danby, Leslie, and Turner, and it is needless to say how charming are many of the above here given."—*Athenæum.*

THE WORKS OF WILLIAM COBBETT.

THE ONLY AUTHORISED EDITIONS.

COBBETT (William): ADVICE TO YOUNG Men and (incidentally) to Young Women, in the Middle and Higher Ranks of Life. In a Series of Letters addressed to a Youth, a Bachelor, a Lover, a Husband, a Father, a Citizen, and a Subject. *New Edition. With admirable Portrait on Steel.* Fcap 8vo. Cloth, 2/6.

"Cobbett's great qualities were immense vigour, resource, energy, and courage, joined to a force of understanding, a degree of logical power, and above all a force of expression, which have rarely been equalled. . . . He was the most English of Englishmen."—*Saturday Review.*

"With all his faults, Cobbett's style is a continual refreshment to the lover of 'English undefiled.'"—*Pall Mall Gazette.*

——— COTTAGE ECONOMY: Containing information relative to the Brewing of Beer, Making of Bread, Keeping of Cows, Pigs, Bees, Poultry, &c.; and relative to other matters deemed useful in conducting the affairs of a Poor Man's Family. *Eighteenth Edition*, revised by the Author's Son. Fcap 8vo. Cloth, 2/6.

WILLIAM COBBETT'S WORKS—*(Continued)*.

COBBETT (Wm.): EDUCATIONAL WORKS.

(See page 25.)

——— A LEGACY TO LABOURERS: An

Argument showing the Right of the Poor to Relief from the Land. With a Preface by the Author's Son, JOHN M. COBBETT, late M.P. for Oldham. *New Edition.* Fcap 8vo. Cloth, 1/6.

"The book cannot be too much studied just now."—*Nonconformist.*

"Cobbett was, perhaps, the ablest Political writer England ever produced, and his influence as a Liberal thinker is felt to this day. . . . It is a real treat to read his strong racy language."—*Public Opinion.*

——— A LEGACY TO PARSONS: Or, have the

Clergy of the Established Church an Equitable Right to Tithes and Church Property? *New Edition.* Fcap 8vo. Cloth, 1/6.

"The most powerful work of the greatest master of political controversy this country has ever produced."—*Pall Mall Gazette.*

DALGAIRNS (Mrs.): THE PRACTICE OF

COOKERY, adapted to the business of Every-day Life. By Mrs. DALGAIRNS. *he best book for Scotch dishes.* About Fifty new Recipes have been added to the present Edition, but only such as the Author has had adequate means of ascertaining to be valuable. *Seventeenth Edition.* Fcap 8vo. Cloth. (*In preparation.*)

GILMER'S INTEREST TABLES; Tables for

Calculation of Interest, on any sum, for any number of days, at ½, 1, 1½, 2, 2½, 3, 3½, 4, 4½, 5 and 6 per Cent. By ROBERT GILMER. Corrected and enlarged. *Eleventh Edition.* 12mo. Cloth, 5/.

GRÆME (Elliott): BEETHOVEN: a Memoir.

With Portrait, Essay, and Remarks on the Pianoforte Sonatas, with Hints to Students, by DR. FERDINAND HILLER, of Cologne. *Third Edition.* Crown 8vo. Cloth gilt, elegant, 5/.

"This elegant and interesting Memoir. . . . The newest, prettiest, and most readable sketch of the immortal Master of Music."—*Musical Standard.*

"A gracious and pleasant Memorial of the Centenary."—*Spectator.*

"This delightful little book—concise, sympathetic, judicious."—*Manchester Examiner.*

"We can, without reservation, recommend it as the most trustworthy and the pleasantest Memoir of Beethoven published in England."—*Observer.*

"A most readable volume, which ought to find a place in the library of every admirer of the great Tone-Poet."—*Edinburgh Daily Review.*

——— A NOVEL WITH TWO HEROES.

Second Edition. In 2 vols. Post 8vo. Cloth, 21/.

"A decided literary success."—*Athenæum.*

"Clever and amusing . . . above the average even of good novels . . . free from sensationalism, but full of interest . . . touches the deeper chords of life . . . delineation of character remarkably good."—*Spectator.*

"Superior in all respects to the common run of novels."—*Daily News.*

"A story of deep interest. . . . The dramatic scenes are powerful almost to painfulness in their intensity."—*Scotsman.*

THE EMERALD SERIES OF STANDARD AUTHORS.

Illustrated by Engravings on Steel, after STOTHARD, LESLIE, DAVID ROBERTS, STANFIELD, Sir THOMAS LAWRENCE, CATTERMOLE, &c., Fcap 8vo. Cloth, gilt.

Particular attention is requested to this very beautiful series. The delicacy of the engravings, the excellence of the typography, and the quaint antique head and tail pieces, render them the most beautiful volumes ever issued from the press of this country, and now, unquestionably, the cheapest of their class.

BURNS' (Robert) SONGS AND BALLADS. With an Introduction on the Character and Genius of Burns. By THOMAS CARLYLE. Carefully printed in antique type, and illustrated with Portrait and beautiful Engravings on Steel. *Second Thousand.* Cloth, gilt edges, 3/.

BYRON (Lord): CHILDE HAROLD'S PILGRIMAGE. With Memoir by Professor SPALDING. Illustrated with Portrait and Engravings on Steel, by GREATBACH, MILLER, LIGHTFOOT, &c., from Paintings by CATTERMOLE, Sir T. LAWRENCE, H. HOWARD, and STOTHARD. Beautifully printed on toned paper. *Third Thousand.* Cloth, gilt edges, 3/.

CAMPBELL (Thomas): THE PLEASURES OF HOPE. With Introductory Memoir by the Rev. CHARLES ROGERS, LL.D., and several Poems never before published. Illustrated with Portrait and Steel Engravings. *Second Thousand.* Cloth, gilt edges, 3/.

CHATTERTON'S (Thomas) POETICAL WORKS. With an Original Memoir by FREDERICK MARTIN, and Portrait. Beautifully illustrated on Steel, and elegantly printed. *Fourth Thousand.* Cloth, gilt edges, 3/.

GOLDSMITH'S (Oliver) POETICAL WORKS. With Memoir by Professor SPALDING. Exquisitely illustrated with Steel Engravings. *New Edition.* Printed on superior toned paper. *Seventh Thousand.* Cloth, gilt edges, 3/.

GRAY'S (Thomas) POETICAL WORKS. With Life by the Rev. JOHN MITFORD, and Essay by the EARL of CARLISLE. With Portrait and numerous Engravings on Steel and Wood. Elegantly printed on toned paper. *Eton Edition, with the Latin Poems. Sixth Thousand.* Cloth, gilt edges, 5/.

HERBERT'S (George) POETICAL WORKS. With Memoir by J. NICHOL, B.A., Oxon, Prof. of English Literature in the University of Glasgow. Edited by CHARLES COWDEN CLARKE. Antique headings to each page. *Second Thousand.* Cloth, gilt edges, 3/.

KEBLE (Rev. John): THE CHRISTIAN YEAR. With Memoir by W. TEMPLE, Portrait, and Eight beautiful Engravings on Steel. *Second Thousand.*

Cloth, gilt edges, ...	5/.
Morocco, elegant, ...	10/6.
Malachite, ...	12/6.

THE EMERALD SERIES—(*Continued*).

POE'S (Edgar Allan) COMPLETE POETICAL

WORKS. Edited, with Memoir, by JAMES HANNAY. Full-page Illustrations after WEHNERT, WEIR, &c. Toned paper. *Thirteenth Thousand.*

Cloth, gilt edges, ... 3/.
Malachite, ... 10/6.

Other volumes in preparation.

MACKEY'S FREEMASONRY:

A LEXICON OF FREEMASONRY. Containing a definition of its Communicable Terms, Notices of its History, Traditions, and Antiquities, and an Account of all the Rites and Mysteries of the Ancient World. By ALBERT G. MACKEY, M.D., Secretary-General of the Supreme Council of the U.S., &c. *Eighth Edition*, thoroughly revised with APPENDIX by Michael C. Peck, Prov. Grand Secretary for N. and E. Yorkshire. Handsomely bound in cloth, 6/.

"Of MACKEY'S LEXICON it would be impossible to speak in too high terms; suffice it to say, that, in our opinion, it ought to be in the hands of every Mason who would thoroughly understand and master our noble Science. . . . No Masonic Lodge or Library should be without a copy of this most useful work."—*Masonic News.*

HENRY MAYHEW'S CELEBRATED WORK ON THE STREET-FOLK OF LONDON.

LONDON LABOUR AND THE LONDON

POOR: A Cyclopædia of the Condition and Earnings of *those that will work and those that cannot work.* By HENRY MAYHEW. With many full-page Illustrations from Photographs. In three vols. Demy 8vo. Cloth. Each vol. 4/6.

"Every page of the work is full of valuable information, laid down in so interesting a manner that the reader can never tire."—*Illustrated London News.*

"Mr. Henry Mayhew's famous record of the habits, earnings, and sufferings of the London poor."—*Lloyd's Weekly London Newspaper.*

"This remarkable book, in which Mr. Mayhew gave the better classes their first real insight into the habits, modes of livelihood, and current of thought of the London poor."—*The Patriot.*

The Extra Volume.

LONDON LABOUR AND THE LONDON

POOR: *Those that will not work.* Comprising the Non-workers, by HENRY MAYHEW; Prostitutes, by BRACEBRIDGE HEMYNG; Thieves, by JOHN BINNY; Beggars, by ANDREW HALLIDAY. With an Introductory Essay on the Agencies at Present in Operation in the Metropolis for the Suppression of Crime and Vice, by the Rev. WILLIAM TUCKNISS, B.A., Chaplain to the Society for the Rescue of Young Women and Children. With Illustrations of Scenes and Localities. In one large vol. Royal 8vo. Cloth, 10/6.

"The work is full of interesting matter for the casual reader, while the philanthropist and the philosopher will find details of the greatest import."—*City Press.*

Mr. Mayhew's London Labour—(*Continued*).

Companion volume to the preceding.

THE CRIMINAL PRISONS OF LONDON,

and Scenes of Prison Life. By Henry Mayhew and John Binny. Illustrated by nearly two hundred Engravings on Wood, principally from Photographs. In one large vol. Imperial 8vo. Cloth, 10/6.

This volume concludes Mr. Henry Mayhew's account of his researches into the crime and poverty of London. The amount of labour of one kind or other, which the whole series of his publications represents, is something almost incalculable.

*** This celebrated Record of Investigations into the condition of the Poor of the Metropolis, undertaken from philanthropic motives by Mr. Henry Mayhew, first gave the wealthier classes of England some idea of the state of Heathenism, Degradation, and Misery in which multitudes of their poorer brethren languished. His revelations created, at the time of their appearance, universal horror and excitement—that a nation, professedly *Christian*, should have in its midst a vast population, so sunk in ignorance, vice, and very hatred of Religion, was deemed incredible, until further examination established the truth of the statements advanced. The result is well known. The London of Mr. Mayhew will, happily, soon exist only in his pages. To those who would appreciate the efforts already made among the ranks which recruit our "dangerous" classes, and who would learn what yet remains to be done, the work will afford enlightenment, not unmingled with surprise.

POE'S (Edgar Allan) COMPLETE POETICAL

WORKS. Edited, with Memoir, by James Hannay. Full-page Illustrations after Wehnert, Weir, and others. In paper wrapper. Illustrated, 1/6.

SOUTHGATE (Mrs. Henry): THE CHRIS-

TIAN LIFE: Thoughts in Prose and Verse from the Best Writers of all Ages. Selected and Arranged for Every Day in the Year. *Second Edition.* Cloth Elegant, ... 5/.
Morocco Antique, ... 10/6.

THOMSON (Spencer, M.D., L.R.C.S., Edinburgh,

and J. C. STEELE, M.D., of Guy's Hospital):

DOMESTIC MEDICINE AND HOUSEHOLD SURGERY (A Dictionary of). Thoroughly Revised and in part Re-Written by the Editors. With a Chapter on the Management of the Sick-room, and many Hints for the Diet and Comfort of Invalids. With many new Engravings. *Twenty-fifth Edition.* Royal 8vo. Cloth, 10/6. (See page 3 of Wrapper.)